

# THE FERN GAZETTE

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## SPORE MORPHOLOGY AND CYTOLOGY OF *ISOETES AZORICA* (PTERIDOPHYTA ISOETACEAE) AND ITS AFFINITY WITH NORTH AMERICA

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Key words: *Isoetes azorica*, cytology, spore morphology, phytogeography

### ABSTRACT

*Isoetes azorica* is an endemic of shallow, oligotrophic lakes in the Azores Islands. Cytological investigations determine it to be tetraploid ( $2n=44$ ). Morphological studies indicate that it shares many characteristics with the North American tetraploid *I. tuckermanii*. The spore morphology of both species is illustrated by SEM and their degree of similarity discussed. The apparently close affinity between these two taxa is consistent with phytogeographic patterns noted with few other pteridophytes of this region.

### INTRODUCTION

The opportunity arose in the autumn of 1992 for the first author to visit the Azores. It was a chance to see new ferns in new surroundings. The flight went directly to Ponta del Gada on Sao Miguel, allowing several days for exploring the island. The detailed observations of Wilmanns and Rasbach (1973), together with their distribution maps proved to be most useful. A side excursion was made to the island of Flores in order to collect *Isoetes azorica* Dur. ex Milde. Our purpose was to obtain material from which to study the SEM of the spores, determine the chromosome number of the species and attempt to show the relationship of this endemic species to others in the world.

### MATERIALS AND METHODS

Two collections of *Isoetes azorica* from which cytological and morphological observations were derived were made on Flores Island:

1. D.M. Britton 13,336, 17 September 1992: Lagoa Lomba (OAC); a thick sward of deeply rooted plants from the shallows out to ca. 1 m deep growing in gravel, cinders and mud. The lake has a broad, open, shallow basin in the open (maximum depth ca. 15 m) at ca. 670 m elevation.

2. D.M. Britton 13,348, 18 September 1992: Caldiera Rasa; a few, small plants in shallow water near the shore (OAC). The lake has a broad, shallow basin in the open at ca. 520 m elevation with Sphagnum moss and low vegetation back from the edge.

The plants were grown in distilled water at 18°C in a growth chamber. The cytological methods employed were those in Britton and Brunton (1989). The standard methods of Britton and Brunton (1989, 1992) were used for the SEM of spores.

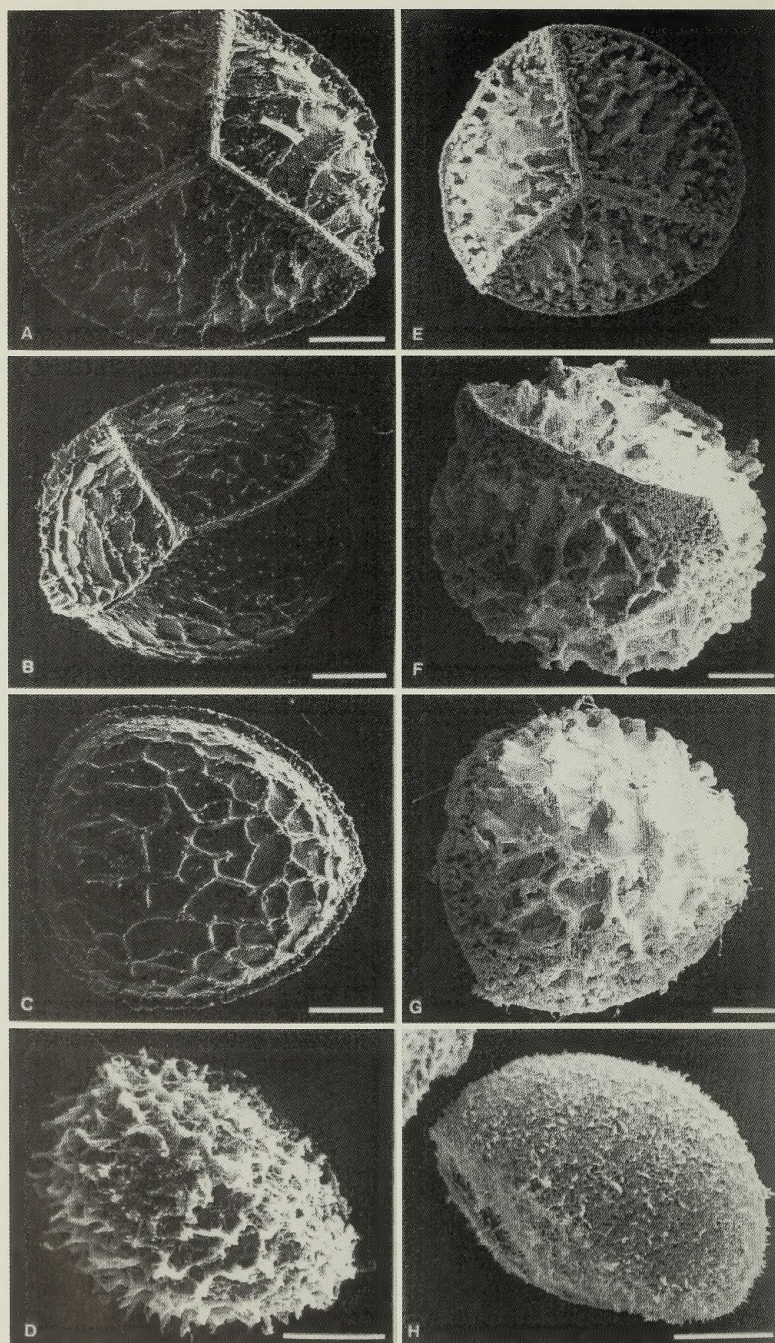
### RESULTS

#### *Plant morphology*

The morphological features of *I. azorica* and *I. tuckermanii* A. Br. are summarized in Table 1. Both are small to moderate size quillworts with *I. azorica* typically having longer, less recurved, brighter green leaves and with a larger velum fenestra<sup>1</sup> exposing an unpigmented sporangium surface.

<sup>1</sup> The size of the opening in the velum created by its partial coverage of the sporangium is one of the few *Isoetes* identification features which can be observed with the naked eye or through a low power lens. We are using the new term *fenestra* ('window' in Latin) to describe it (Brunton and Britton 1996).





**Figure 1.** A-D SEM of spores of *I. azorica* (D.M. Britton 13,336, 17 September 1992. Azores, Flores, Lagoa Lomba [OAC] ); E-H SEM of spores of *I. tuckermanii*: E& G D.M. Britton & J.P. Goltz 11,895B, 23 September 1988. Canada, New Brunswick, Grand Lake (OAC); F& H M. Sharp 1,954, 25 August 1987. Canada, Ontario, Parry Sound District, McQuaby Lake (OAC).

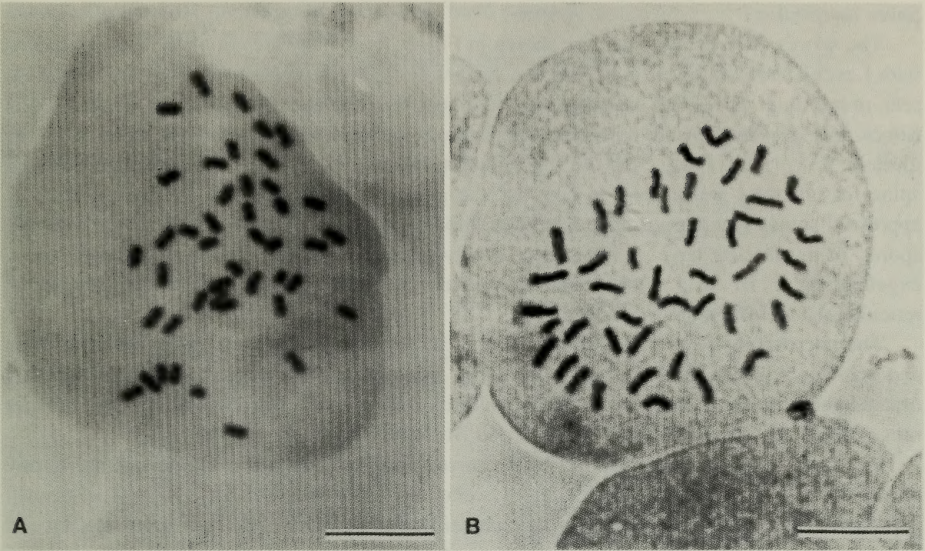
A & E Proximal or triradial views of megaspores (Bar = 100  $\mu$ m)

B & F Lateral views of megaspores (Bar = 100  $\mu$ m)

C & G Distal views of megaspores (Bar = 100  $\mu$ m)

D & H Microspores (Bar = 7.5  $\mu$ m)





**Figure 2.** A. Arrested metaphase plate of chromosomes from *I. azorica* (D.M. Britton 13,336) (Bar = 10  $\mu$ m) B. Arrested metaphase plate of chromosomes from *I. tuckermanii* (M. Sharp 1,954) (Bar = 10  $\mu$ m)

A number of plants of *I. azorica* from Lagoa Lomba (D.M. Britton 13,336) have tiny (<2 cm long) plantlets originating from between the leaf bases, apparently arising from the leaf tissue at the base or from the sides of the sporangia. These appear to be vegetative gemmae such as those described as occurring rarely in *I. lacustris* L. in France and more commonly in several South American species (Hickey 1986).

**Table 1. Morphological features of *Isoetes azorica* and *I. tuckermanii***

	<i>Isoetes azorica</i>	<i>Isoetes tuckermanii</i>
<b>Corm</b>	two-lobed	globose, two (three)-lobed
<b>Leaves</b>	evergreen, bright yellow green; paler towards base; to 30 cm long.	partially evergreen, olive green to reddish brown when mature pale towards base; to 20 cm long.
<b>Velum</b>	extends across 1/3 to 1/2 of the sporangium 43.7% (N=6)	extends across 1/2 or less of the sporangium 30.94% (N=8)
<b>Sporangium wall</b>	unpigmented	brown-streaked
<b>Megaspores</b>	458.4 (N=50)	486.7 (N=50)
Size ( $\mu$ m)		
<b>proximal face</b>	covered in narrow, low, distinct crests	strongly, roughly ridged
<b>lateral face</b>	girdle obscure or lacking	girdle pronounced, densely papillate
<b>distal face</b>	regularly-reticulate; muri low	irregularly reticulate; muri high
<b>Microspore</b>		
<b>Colour (in mass)</b>	light brown	gray
<b>Size (<math>\mu</math>m)</b>	30-(34.4)-40 (N=30)	25-35 (Taylor & Luebke <i>et al.</i> 1993)
<b>Ornamentation</b>	very strongly spinulose	lightly spinulose to almost smooth



### Spore morphology

The spores of *Isoetes azorica* are shown in Fig. 1, A-D. They are compared and contrasted with *I. tuckermanii* in Fig. 1, E-H. The two species have spores with many basic similarities. As seen in proximal view, both have low crests without reticulations and both have broad triradial ridges. In *I. tuckermanii* the crests and ridges are wider than in *I. azorica*. In lateral view the girdle in *I. azorica* is fairly clear of ornamentation although a few spaced, short, wide, rounded spines or tubercles are present. In contrast, the girdle of *I. tuckermanii* has an abundance of appressed spines that form a wide band that appears papillate or foveolate. In distal view the spores of *I. azorica* have a very neat, evenly-reticulate pattern that is reminiscent of *I. engelmannii* A. Br. In *I. tuckermanii*, however, the walls (muri) of its similar pattern of reticulations are irregularly scalloped.

The microspores seem quite different (Fig. 1, D and H). Those of *I. azorica* are very rough and echinate with an abundance of large spines whereas in *I. tuckermanii* they are sparsely ornamented with short spines of a narrow calibre or are smooth. For illustrations of a broader range of microspore morphology see Kott and Britton (1983).

The megaspores and microspores of *I. azorica* as seen under SEM are not similar to any western European species (Berthet and Lecocq 1977, Ferrarini et al. 1986). The nearest approach would seem to be the spores of *I. duriei* Bory, but in this species the proximal face of the megaspore is as reticulate as the distal face, and the microspores are papillate and similar in appearance to those of *I. lacustris*.

### Cytology

Arrested metaphase plates of the chromosomes of *I. azorica* and *I. tuckermanii* are shown in Fig. 2, A and B. In both species the somatic chromosome number is 44 and the chromosomes are all much the same length. None are very long; after pretreatment they range from 1.5 - 2.5  $\mu\text{m}$  in length. In width they are undistinguished, looking very like other aquatic tetraploids such as *I. riparia* Engelm. and *I. maritima* Underw. (Britton and Brunton 1989, 1996). The chromosomes are wider than those of the terrestrial or amphibious species such as *I. butleri* Engelm. and *I. melanopoda* Gay & Dur.

### Ecology

Extensive ecological observations on *I. azorica* from seven lakes on four islands of the Azorean archipelago are given by Pietsch (1994). The species is characterised as one of oligotrophic lakes with weakly acid, low lime substrates. As with North American aquatic species (Taylor and Luebke et al. 1993), *I. azorica* does not compete successfully in sites which become enriched with nutrients. Under such circumstances plants of *I. azorica* are replaced by such species as *Littorella uniflora* (L.) Asch., *Potamogeton polygonifolius* Pour. and *Eleogiton fluitans* (L.) Link.

### Phytogeography

Since *I. azorica* and the North American *I. tuckermanii* appear to be morphologically and cytologically closely related it is worthwhile to see whether there are other examples which might give a clue as to the closeness of this relationship. Dansereau (1961) considered 88 species of pteridophytes in Macronesia. Of these, 58 species occurred in the Azores (Madeira 55, Canary Island 48 and Cape Verde Islands 36). Table 2 lists the 17 Azorean species that are familiar to the authors from the flora of North America. For the purposes of postulating a possible North American origin for an Azorean species (*I. azorica*) we must reject those species in Table 2 that could have originated in Europe. This eliminates all the species except for the segregate of *D. dilatata* (Hoffm.) A. Gray, (*D. intermedia* (Muhl. ex Willd.) A. Gray) and *Asplenium monanthes* L. *Dryopteris intermedia* is a common woodland species in northeastern North America (Montgomery and Wagner 1993) while *Asplenium monanthes* is considered to be primarily a tropical American species (Wagner et al. 1993).

There have been many studies on Azorean pteridophytes since 1961. Bennert et al. (1992) cite 12 papers to update Carvello e Vasconcellos (1968) and bring the total number of taxa listed



**Table 2. Pteridophyte species in the Azores and North America**

(from Dansereau 1961)

[Specimen numbers and geographical distribution also from Dansereau (1961)]

3.	<i>Equisetum telmateia</i> Ehr.	Circumboreal
9.	<i>Lycopodium inundatum</i> L.	Subcosmopolitan-temperate
10.	<i>Lycopodium selago</i> L.	Circumboreal
17.	<i>Ophioglossum vulgatum</i> L.	Circumboreal
18.	<i>Botrychium lunaria</i> (L.) Sw.	Subcosmopolitan-temperate
19.	<i>Osmunda regalis</i> L.	Subcosmopolitan-subtropical-temperate
24.	<i>Pteridium aquilinum</i> (L.) Kuhn	Cosmopolitan
40.	<i>Adiantum capillus-veneris</i> L.	Subcosmopolitan-subtropical-temperate
60.	<i>Dropteris dilatata</i> (Hoffm.) A. Gray	Circumboreal <sup>1</sup>
63.	<i>Thelypteris limbosperma</i> (All.) Fuchs	Circumboreal
65.	<i>Cystopteris fragilis</i> (L.) Bernh. var. <i>diaphana</i> (Bory) C. Chr.	Subcosmopolitan-temperate
66.	<i>Athyrium filix-femina</i> (L.) Roth	Circumboreal
71.	<i>Blechnum spicant</i> (L.) Roth	Circumboreal
72.	<i>Asplenium monanthes</i> L.	Subcosmopolitan-tropical-hot temperate
81.	<i>Asplenium ruta-muraria</i> L.	Circumboreal
82.	<i>Asplenium scolopendrium</i> L.	Circumboreal
83.	<i>Asplenium septentrionale</i> L.	Subcosmopolitan-temperate
84.	<i>Asplenium trichomanes</i> L. var. <i>majus</i> Mett.	Subcosmopolitan-temperate

<sup>1</sup> Although Dansereau considered *D. dilatata* circumboreal (present in Europe, North America, northern Himalayas as well as Azores and Madeira), it is no longer so considered. *Dropteris dilatata* is presently considered to be primarily a European species rare in the Azores and replaced in North America by *D. campyloptera* Clarkson.

in the literature to 83. Some additions to the flora are recent arrivals and might be considered aliens. Nevertheless, it is clear that the Azores, geographically at the mid-point of the Atlantic Ocean, has a pteridophyte flora with more affinities with Europe than with the Americas.

The nearest parallel to the relationship of *I. azorica* with *I. tuckermanii* would seem to be *Dryopteris azorica* (Christ.) Alston with *D. intermedia*. In both cases we have an Azorean endemic that has much in common with a species in northeastern North America. Gibby et al. (1977) stated that *D. azorica* has the same ancestral genomes as *D. intermedia* and *D. maderensis* Alston but is maintained as a separate species because of "small morphological differences and distinct ecological differences" together with geographic separation. *Dryopteris azorica*, for example, does not have the characteristic glands that appear on the indusia and axis of the fronds of *D. intermedia*. In Gibby (1985) the Azorean flora of *Dryopteris* consists of five species and five interspecific hybrids. Derrick et al. (1987) list *D. azorica* as *D. intermedia* (O.F. Muell. ex Willd.) A. Gray ssp. *azorica* (Christ) Jermy. This emphasizes the close relationship of these two taxa.

One might also ask whether *I. azorica* would not be better considered a subspecies of *I. tuckermanii*. This would certainly emphasize the apparently close relationship between the two taxa. Both are tetraploids occurring entirely or primarily along the Atlantic Ocean coast and both share similarities in spore morphology. Significant differences occur, however, in microspore morphology (Fig. 1, D vs. H) and megaspores ornamentation (e.g. marked papillate appearance of the girdle in *I. tuckermanii* (Fig. 1, F) and the neat, regular reticulations on the distal face of *I. azorica* (Fig. 1.C)). The apparent high incidence of endemism in *Isoetes* taxa isolated on oceanic islands throughout the world (Hickey 1981; Britton & Brunton 1991; Taylor & Wagner et al. 1993) also tends to emphasize the uniqueness of *I. azorica*. We also suspect that *I. tuckermanii* which occurs as far north as Newfoundland in eastern Canada (Cody and Britton 1989) is more winter hardy than is *I. azorica*. As well, the leaves of the latter do not disappear in autumn. In combination, therefore, these considerations argue more forcefully for maintaining *I. azorica* as a distinct, endemic Azorean species.



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## NEW FLORISTIC RECORDS FOR THE FERN FLORA OF TURKEY

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### ABSTRACT

New records are given for 23 fern species in Turkey.

### INTRODUCTION

In this study new records are given for 23 fern species for the squares A 1 (A), A 2 (A), A3 , A 4, A 5, A 6, A 7, A 8, B 1, B 2, B 3 of the flora of Turkey. Additions are made to the distributional data of taxa listed in P.H. Davis, Flora of Turkey and East Aegean Islands, Vol. 1, 10, Edinburgh, 1965, 1988. The floristic works published so far (see references) were consulted in order to ensure that the records mentioned here are new for these grid squares. The references cited for each species are from various floristic works of Turkey. The distributions of these species are marked on the map (Figure 1-9). Herbarium specimens have been deposited in the Biology Department, Science Faculty, Uludağ University, Bursa (BURSA). The abbreviations used the list are as follows: New record for a specific square (\*\*), Herbarium of University of Uludağ (BULU), Herbarium of University Istanbul (ISTF, ISTE, ISTO), Herbarium of University of Dicle (DUF), Herbarium of University Ege (EGE), Mountain (Mo.)

### ADIANTACEAE

*Cheilanthes pteridioides* (Reich.) C. Chr.

A 2 (A): ISTANBUL: Prinkipo Azn. (Davis 1965).

B 1: IZMİR: Smyrna, Bornm. 10226. (Davis 1965).

**\*\*B 3**: ISPARTA: Uluborlu: Akçay location, valley, rocky and stony slopes, 1000-1300 m, 20.7.1995, G.Kaynak, BULU 9484.

B 8: DIYARBAKIR: Lice to Diyarbakır, 31 km, rocks, 15.3.1977, G. Kaynak, DUF 1049. (Demiriz and Kaynak 1977).- SIIRT: Kozluk: Malabadi to Sason, 22 km, around Çevrecik, oaks, rocks, 870 m, 30.4.1978, G.Kaynak, DUF 1519 (Kaynak 1980).

C 1: IZMİR: Selçuk: Efes ruins, on rocks, 15.9.1967, M.Önder et H.Kayacık fil. ISTO 6049. - AYDIN: Söke: Milet ruins, on walls of amphitheatre, 10.5.1965, H.Kayacık et F.Yaltırık, ISTO 3545 (Demiriz et all. 1969).

C 2: MUĞLA: Fethiye, 30 m, D. 25421 (Davis 1965).

C 3: ANTALYA: Aspendos nr. Serik, Walter 3955 (Davis 1965). - Ancient Roma ruins, 23.5.1950, M.Heilborn et A. Atilla. - Aksu: Toparlar, Perge ruins, amongst walls of ruins, 24.2.1968, K.Kaymak, ISTF 26100.

C 4: IÇEL: Silifke, Sauer 53 (Davis 1965).- Alanya: Alanya castle, amongst ruins, 5.2.1966, A.et T. Baytop, ISTE 8578 (Demiriz et all. 1969).

C 5: IÇEL: Gysel De., 560 m, Siehe 1895:143 (Davis 1965).- ADANA: Pozantı to Ulukışla ,10 km, on rocks, 25.3.1967, H.Demiriz, ISTF 2517 (Demiriz et all. 1969).

C 6: HATAY: Latakia to Antakya, Walter 1017. - ISKENDURUN: Iskendurun to Ceyhan, 57 km: Toprakkale ruins, on walls of ruins, 24.3.1967, H.Demiriz, ISTF 25167 (Demiriz et all. 1969).

C 7: ADIYAMAN: Kahta: Kahta to Damlacık 1.5 km, Cendere bridge, valley, rocks, 10.6.1978, G.Kaynak, DUF 1773 (Kaynak 1980).

### *C. persica* (Bory) Kuhn

**\*\*A 2 (A)**: BURSA: between Orhaneli and Keles, around Göynükbelen, rocks, 500 m, 1.7.1987, G.Kaynak and O.Belioğlu, BULU 2465 (Kaynak and Tuyji 1991).

A 7: GÜMÜSHANE: Gümüşhane 1850 m, Balls 1730 (Davis 1965).

A 8: ARTVIN: Çoruh: nr Artvin (Davis 1965).

A 9: ERZURUM: nr. Oltu (Davis 1965).



- B 2: BALIKESİR: Sındırgı, rock crevices, 900 m, 5.7.1987, O.Benlioğlu, BULU 6438 (Kaynak and Tuyji 1991).- BURSA: Harmancık: around Tunçbilek, rocks, 680 m, 6.7.1991, O.Benlioğlu, BULU 6360. - USAK: Murat Mo., Pınarçayı location 1100 m, 19.5.1978, A.Çırpıcı 31620 (Çırpıcı 1989).
- \*\* B 3: ISPARTA:** Uluborlu, Akçay location, valley, rock and stony slopes, 1000-1300 m, 20.7.1995, G.Kaynak, BULU 9483. - AFYON: Incehisar, rocks, 1190 m, 10.6.1995, O.Benlioğlu, BULU 9511.
- B 4: ANKARA: Hasanoğlu, amongst rocks, 10.5.1945, H.Bağda. 1140. - Balato Kaman, 33 km: Near Köprüköyü, beside Kızılırmak, granite rocks, 730 m, 23.9.1968, H.Demiriz, ISTF 26630 - KONYA: Aksaray: Koçhisar road, near Tuz gölü, stony steppe, 900 m, 23.2.1955, H.Demiriz, 2357 (Demiriz et all. 1969).
- B 7: TUNCELI: 7 km SW of Pertek, near the bridge over the river Murat, 1200 m, 28.5.1959, İter Leydenense 1553. - ELAZIĞ: Keban: Keban to Poyraz, 3 km, riverside, rocks, 880 m, 18.6.1977, G.Kaynak, DUF 1280. - DIYARBAKIR: Ergani: Ergani to Maden, 8 km, gorge, rocky and stony slopes, 30.3.1975, H.Demiriz and Ö. Saya, DUF 52 (Demiriz and Kaynak 1977). - TUNCELI: Tunceli to Ovacık, 16 km: Munzur valley, rocks, 970m, 20.6.1981, G.Kaynak, DUF 2827 (Kaynak 1980). - ERZINCAN: Eğin (Kemaliye) Sint 1890: 2250 (Davis 1965).
- C 1: AYDIN: Priene, Bornm. 10227 (Davis 1965)
- C 2: MUĞLA: Muğla, 5 km NW, maquis, 450 m, 12.5.1967, H.Pesmen 2003 (Demiriz et all. 1969).
- C 3: ANTALYA: Çubuk pass, above pass, rocks, 875-900 m, 28.9.1968, H.Demiriz, ISTF 26684. - Alanya: Kozlu: 1200 m, D. 15754. (Davis 1965).- BURDUR: Burdur to Çeltikçi, 20 km, rocks, 1200-1250 m, 28.9.1968, H.Demiriz, ISTF 26687. - KONYA: Beyşehir to Akseki, 27 km, stony, rocky slopes, 1200 m, 29.4.1961, H.Demiriz 4497. (Demiriz et all. 1969).
- C 4: KONYA: around Apa Barajı, 1000 m, 78-25-7, Ehrend. et all. (Sorger 1984).
- C 5: ADANA: Seyhan: Kozan, 300 m, D. 26614. - IÇEL: Portes Ciliciennes, Ball 759 (Davis 1965). - NIĞDE: Çiftahan to Pozantı, 5 km, Horozderesi valley, conglomeratic rocks, N, 900 m, 25.9.1968, H.Demiriz, ISTF 26645. - ADANA: Pozantı: Sekerpinarı SW above mixed forest (*Abies*, *Pinus*, *Cedrus*), rocky and stony slopes, 1300 m, 25.9.1968, H.Demiriz, ISTF 26652 (Demiriz et all. 1969).
- C 6: MARAS: Döldül Mo., Haradj. 3885 (Davis 1965).
- C 7: ADIYAMAN: Kahta: Damlacık, Old castle, on walls of Cistern, rocks, 10.6.1978, G.Kaynak, DUF 1778 (Kaynak 1980).
- C 8: DIYARBAKIR: Çınar: Çınar to Mardin, 14 km, rocky slopes, 6.4.1975, H.Demiriz, DUF 84 (Demiriz and Kaynak 1977).

### *C. marantae* (L.) Domin *subsp. marantae*

- \*\*A 2 (A): YALOVA:** Termal, around Gökçedere, maquis, 100 m, 18.5.1995, G.Kaynak, BULU 411. - BURSA: Orhaneli, on serpetin rocks, 700 m, 1.7.1992, G.Kaynak and O.Benlioğlu, BULU 6381.
- A 3: ZONGULDAK: Dirgine to Devrek, 180 m, D. 37906 (Davis 1965).
- A 4: ANKARA: Çankırı: Eldivan: above Seydiköy, steppe, rocky slopes, 1300-1350 m, 9.8.1984, Yıldırımılı 7405 (Yıldırımılı 1987).
- A 5: KASTAMONU: Tosya, zwischen Felsen, 23.7.1933, W. Kotte (Demiriz et all. 1969).
- A 8: GÜMÜSHANE: Bayburt, Boiss (Davis 1965)
- A 9: KARS: E. of Koser, Sauer 306 (Davis 1965).
- B 1: ÇANAKKALE: in valley Dumbrek, Sint. 1883: 281 (Davis 1965).
- \*\*B 2: BALIKESİR:** Dursunbey, Kazdağ, nortfacing slopes of Asar hill, rocs, 1000 m, 6.6.1987, O.Benlioğlu, BULU 600. - Alaşam Mo., Cardere pass, N slopes of Gavur Mo, stony slopes, 1000 m, 6.6.1987, O.Benlioğlu, BULU 6134.- BURSA: Harmancık: Kocapınar village, on serpentin rocks, 950 m, 8.7.1992, O.Benlioğlu, BULU 6415.
- B 3: KÜTAHYA: Dumlupınar: Otlukçu hill, 1200 m, 31.3.1982. (T.Ekim et all. 1985).
- B 4: ANKARA: Bala: Beynam *Pinus nigra* forest, 1300-1500 m, 15.5.1986, S. Yıldırımılı 9221 (Yıldırımılı and Güner 1989).
- B 7: ERZINCAN: Kesis Da, 2700 m, D. 31652. - MALATYA: Bey Da., supra Malatia, Hausskn. (Davis 1965).
- B 8: MUS: Ziyaret Tepe, 2000 m, Akbar (Davis 1965). - ERZURUM: İspir: screes of Gültepe, on rocks, 1200 m, 15.7.1995, N.Simsek, BULU 9524 B.
- C 1: MUĞLA: Piriene, Bornm. 10227 (Davis 1965).
- C 3: ANTALYA: Atbükü, 25.5.1950, M. Heilborn et A. Atilla (Demiriz et all. 1969).
- C 5: ADANA: Seyhan: Sencan De, 1000 m, D. 19586 B (Davis 1965).
- C 6: ADANA: Seyhan: Dumanlı Mo., Amonos Da., between Kapılı and Çat village, 600-1000 m, 12.10.1951, I. Akbas 256, ISTO 311 (Demiriz et all. 1965).



*Anogramma leptophylla* (L.) Link

- \*\*A 1 (A):** BALIKESİR: Marmara Peninsula, rocky places, 100 m, 25.6.1987, O.Benlioğlu, BULU 601 (Kaynak and Tuyji 1991).
- A 2 (A): ISTANBUL: Büyükkada, Ayayorgi tepesi, rocks and edge of river, 160 m, 4.5.1991, O.Benlioğlu, BULU 6170. - Kartal: Cevizli: Dragos tepesi, damp rocks, 50 m, 5.5.1991, O.Benlioğlu, BULU 6179. - Kartal: Yakacık Da, under *Pinus nigra* forest, rocks, 300 m, 26.6.1992, O.Benlioğlu, BULU 6399. - BURSA: Gemlik: around Armutlu thermal spring, maquis, 110 m, 28.4.1988, O.Benlioğlu, BULU 2900. - Gemlik: Karacaali: edge of river, rocks, 350 m, 24.6.1992, G.Kaynak and M.Göçmen, BULU 6399 A
- A 7: TRABZON: 3-4 km W of Trabzon, Sauer 186 (Davis 1965).
- A 8: RIZE: Rize, Bal. (Davis 1965).
- B 1: IZMİR: Smyrne, Bornm 1906: 10221. (Davis 1965)
- B 8: BITLİS: Baykan to Bitlis, 7 km, valley, rocks, 850 m, 19.6.1976, H.Demiriz, Ö.Saya and G.Kaynak, DUF 595.(Kaynak 1989).
- C 2: MUĞLA: Marmaris, 30 m, D. 25258 (Davis 1965)
- C 3: ANTALYA: Düdenbas, in 15 m, deep canyon of the Düden çayı, humid places, shaded, 40 m, 15.4.1959, İter Leydenense 393. - ANTALYA, around Tat gölü, on rocks, 24. 3.1967, S.Dallı, ISTF 25202. - Aksu: Toparlar: Perge ruins, amongst walls of ruins, 24.2.1968, K.Kaymak, ISTF 26101 (Demiriz et al. 1965).
- C 4: ANTALYA: Alanya: Alanya castle, amongst stones, 25.2.1966, T.Baytop et al., İSTE 8578 a. - İÇEL: Silifke to Mut 22 km, near Değirmendere: Göksu valley, rocks, 21.3.1967, H.Demiriz, ISTF 25127 (Demiriz et al. 1969)
- C 5: Seyhan: Sencan De., 1000 m, D. 19641. - İÇEL: H.Demiriz, ISTF 25132 (Demiriz et al. 1969)
- C 6: HATAY: Dörtöl: Rabat, vertical serpentine flush, Ca. 100 m, 5.5.1965, M.J.E. Coode et B.M.G. Jones 492.

*Adiantum capillus-veneris* L.

- A 1 (E): TEKİRDAĞ: Gaziköy, 13.7.1968, A.Baytop et B.Çubukçu, İSTE 13514. - BALIKESİR: Marmara Peninsula: Altınsuyu spring, on wet rocks, 13.8.1967, A.Aydın, ISTF 25792 (Demiriz 1969).
- A 2 (E): ISTANBUL: Büyük liman, 1200 m, Azn. (Davis 1965).
- A 2 (A): Sile, on damp rocks facing coast, 50 m, 29.10.1966, H.Demiriz 6184 (Demiriz et al. 1969). - BURSA: Armutlu: around Armutlu thermal spring, on shady on wet rocks, 70 m, 6.7.1988, G.Kaynak and O.Benlioğlu, BULU 3220 (Kaynak and Tuyji 1991). - Gemlik: Karacaali, waterfall, rocks, 350 m, 24.6.1992, G.Kaynak and M.Göçmen, BULU 6391. - Karacabey: between Ekinli and Ballıkaya village, valley,damp rocks, 130 m, 5.7.1992, O.Benlioğlu, BULU 6404. - Uludağ: İnkaya village, edge of river, on wet rocks, 420 m, 30.7.1991, O.Benlioğlu, BULU 6301. - YALOVA: Termal, on damp rocks, 110 m, 24.6.1992, O.Benlioğlu, BULU 6390.
- A 3: ADAPAZARI: Söğütlü to Karasu 10 km, on rocks, 30 m, 9.5.1991, O.Benlioğlu, BULU 6352. - BOLU: E of Akçakoca, Kühne 66 (Davis 1965).
- \*\*A 4:** KASTAMONU: between Senpazar and Cide, forest, 960 m, 27.8.1994, G.Kaynak and G.Tarımcılar, BULU 9130.
- A 5: ÇORUM: the province border of Çorum, rocks, 315 m, 24.8.1994, G.Kaynak and G.Tarımcılar, BULU 8977. - SAMSUN: Bafra: Ağcaalan village, 300 m, 25.9.1991, Kutbay 859 (Kutbay and Kılınc 1989). - SINOP: Boztepe Peninsula, around Karakum rivulet, 10-50 m, 7.8.1988, Karaer 533 (Karaer 1993).
- A 6: SAMSUN: 5 km of Samsun, 10 m, Tobey 133 (Davis 1965). - between Samsun and Kirazlı, on wet rocks, 5.5.1966, A.Baytop, İSTE 8965 (Demiriz et al. 1969).
- A 7: TRABZON: 23 km WNW of Trabzon, humid slope, along rivulet, 5 m, 4.6.1959, İter Leydenense 1771 (Demiriz et al. 1969). - GİRESUN: Dereli, damp rocks, 140 m, 25.8.1993, G.Kaynak and G.Tarımcılar, BULU 7758 A -TRABZON: between Trabzon and Bayburt, roadside, rocks, 800 m, 26.8.1993, G.Kaynak and G.Tarımcılar, BULU 7806 (Kaynak and Tuyji 1994).
- A 8: ARTVIN: between Hopa and Artvin, 7.1947, A.Heilborn et M.Basarman (Demiriz et al. 1969). - between Artvin and Erzurum: Düzlülce, edge of river, 240 m, 29.8.1993, G.Kaynak and G.Tarımcılar, BULU 7885. - between Ardahan and Kutul, rocks, 1170 m, 29.8.1993, G.Kaynak and G.Tarımcılar, BULU 7894 (Kaynak and Tuyji 1994).
- A 9: KARS: nr Posof (Davis 1965).
- B 1: IZMİR: Bergama: Asklepion, 30.8.1959, S.Okuyar. - Nif Mo., *Pinus brutia* forest, 29.5.1966, H.Pesmen 1207. - Gümlüdü: in fissures rupium in Pinto brutiae, 5.5.1962, C.Regel. - MANİSA: Akhisar, damp calcareous rocks, 4. 1966, H.Pesmen 1211 (Demiriz et al. 1969). - BALIKESİR: Edremit: Kaz Mo., edge of water, 500 m, 31.7.1987, O.Benlioğlu, BULU 6164 (Kaynak and Tuyji 1991). -

- ÇANAKKALE: between Edremit and Ayvacık, around fountain, 50 m, 12.7.1991, O.Benlioğlu, BULU 6365.
- \*\* B 2: BALIKESİR:** Sındırgı, in vicinities of Emendere thermal spring, rocky places by stream, 600 m, 5.7.1987, O.Benlioğlu, BULU 602. - BURSA: Harmancık: Ilıcaksu thermal spring, on calcareous rocks, 950 m, 8.7.1992, O.Benlioğlu, BULU 6414.
- B 6: Seyhan: Feke, Göksun gorge, 800 m, D. 19885 (Davis 1965).
- B 7: DIYARBAKIR: Çermik: valley of Sinek çayı, rocks, 640 m, 21.8.1976, H.Demiriz and S. Alakus, DUF 1008. - Çüngüş: Çüngüş to Karakaya 9 km, damp rocks, 1050 m, 21.8.1976, H.Demiriz, DUF 1020 (Demiriz and Kaynak 1977, Kaynak 1980).
- B 8: DIYARBAKIR: Eğil: Eğil castle, valley, waterside, 18.4.1977, H.Demiriz and G.Kaynak, DUF 1096. - Hazro: around Uzunargıt, nearwater-mill, along rivulet and rocks, 890-930 m, 3.8.1976, H.Demiriz, DUF 943. - SIIRT: Kozluk: Malabadi to Sason, 26,5 km, rocks, 690 m, 30.4.1978, G.Kaynak, DUF 1525. - Silvan: Silvan to Baykan, 37 km, wet soil, 570 m, 24.4.1979, G.Kaynak, DUF 2160. - Kozluk: Bekirhan, damp rocks, 630 m, 21.5.1978, G.Kaynak, DUF 1661. - BITLİS: Baykan to BITLİS, 13,5 km, valley, damp rocks, 900 m, 19.6.1976, H.Demiriz and G.Kaynak, DUF 597 (Demiriz and Kaynak 1977, Kaynak 1980).
- B 9: Van: Van:, 1899-1900, Maunsell (Davis 1965).
- C 1: AYDIN: Kusadası: SamsunDa, National Park area, 3.10.1965, H.Kayacık et F.Yaltırık, ISTO 4402 (Demiriz et all. 1969).
- C 2: DENİZLİ: Tas ocağı, nr. Denizli, D. 13263. - Pamukkale fountain, 24.2.1963, C.Regel. - ANTALYA: Kas: Islamlar village, dam of water-mill, 15.10.1960, H.Kayacık ISTO 813 (Demiriz et all. 1969).
- C 3: ANTALYA: Kumluca: Beydağı, edge of water, 1500 m, 10.8.1966, F.Seker, ISTO 7987. - Güzeloba: Düden çayı, beside rivulet, "2.1968, K.Kaymak, ISTF 26093. - Manavgat: Manavgat waterfall, edge of waterfall rocks, 27.9.1968, H.Demiriz, ISTF 26674. - KONYA: Beyşehir: Eflatun ruins, 2.6.1955, A. et T.Baytop, ISTE 4344. - BURDUR: Bucak, *Liquidamber orientalis* community, Y.Akman and O.Ketenöğlu (Akman and Ketenöğlu 1992).
- C 4: İÇEL: Anamur to Gazipasa, 16 km, streamside, 27.9.1968, H.Demiriz, ISTF 26667. - between Silifke and Anamur: Değirmenönü, near water-mill of the village, 50 m, 9.9.1962, H.Kayacık ISTO 2960. - Silifke: Cennet deresi, prope fontem, 8.6.1962, C.Regel (Demiriz et all. 1969). - Taseli Platosu: Ermenek: Daran village, Ayaslı location, 600 m, 15.9.1983, Sümbül 2536 (Sümbül 1989).
- C 5: İÇEL: Silifke to Erdemli, 23 km, at the mouth of Cennet-Cehenhem Cavern, on rocks, 21.3.1967, H.Demiriz, ISTF 25134. - Mersin: W fringe of Turunçlu: above locality Pınarbası, rocky high maquis, under rock, 300 m, 30.9.1951, H.Demiriz 807. - HATAY: Antakya: Amonos Mo., damp rocky places, beside water-coduits, 14.4.1967, Y.Akman (Demiriz et all. 1969).
- C 6: MARAS: Andırın: Somaklıköy, 8.7.1951, M.Kaya. - ADANA: Kadirli: between Karatepe and Aslantas, *Pinus brutia* and amongst maquis, on damp places, 1.9.1962, H.Kayacık, ISTO 3076. - Haruniye: N of Karacaören village: Akpınar location, edge of water, 1.8.1968, V.Ünal, ISTF 26733. - HATAY: Antakya: Harbiye, rocks of waterfall, 23.3.1967, H.Demiriz, ISTF 25159 (Demiriz et all. 1969).
- C 7: ADIYAMAN: Kahta: Kahta to Siverek, 4,5 km, damp soil, 10.6.1978, G.Kaynak, DUF 1772. - URFA: Urfa: around castle, rocks, 520 m, 6.8.1976, H.Demiriz, DUF 963 (Kaynak 1989).
- C 8: MARDİN: Monastery of Darzafaran, on walls of well, 900 m, 4.7.1976, H.Demiriz and G.Kaynak, DUF 686 (Demiriz and Kaynak 1977).
- C 9: MARDİN: Cizre to Sırnak, 11 km: Kasrık boğazı, shady river bank near bridge, 400 m, 7.5.1966, P.H.Davis 42641, ISTO 10291 (Demiriz and Kaynak 1977).

## POLYPODIACEAE

### *Polypodium vulgare* L.

- A 1 (E): KIRKLARELİ: Demirköy, SE: slopes facing Değirmendere and valley, on rocks, 22.4.1967, H.Demiriz ISTF 25237 (Demiriz et all. 1969).
- \*\* A1 (A): BALIKESİR:** Erdek: SW of Kapıdağ, maquis, 350 m, 18.7.1991, O.Benlioğlu, BULU 6262.
- A 2 (E): İSTANBUL: Kartal: Yakacık: N slopes of Aydos Mo., maquis and rocks, 450m, 24.6.1992, O.Benlioğlu, BULU 6396. - Büyükkada: Viranbağ, under maquis, on rocks, 90 m, 4.5.1991, O.Benlioğlu, BULU 6423. - YALOVA: around Esadiye village, in *Quercus* forest, rocky slopes, 520 m, 20.2.1990, O.Benlioğlu, BULU 4216. - Termal, in forest, edge of water, rocks, 110 m, 24.6.1992, O.Benlioğlu, BULU 6385.
- A 2 (A): BURSA: Inegöl: Uludağ, Merzukiye village, under *Fagus* forest, on rocks, 1120 m, 7.5.1987, G.Kaynak and O.Benlioğlu, BULU 1936. - Gemlik: Sahintepe, on rocks, 9.6.1989, G.Kaynak and O.Benlioğlu, BULU 4116. - Armutlu: Hayriye village, rocks, 385 m, 5.4.1989, G.Kaynak and O.Benlioğlu, BULU 4099. - Kestel: Sevketiye to Seyfiye, 3 km, under *Fagus* forest, rocks of valley,



- 900 m, 12.5.1988, G.Kaynak and O.Benlioğlu, BULU 2927 (Kaynak and Tuyji 1991). - Iznik: Bayındır village, rocky maquis, 330 m, 29.6.1991, O.Benlioğlu, BULU 6341. - Yenisehir: Avdan Mo., in maquis, on rocks, 640 m, 29.6.1991, O.Benlioğlu, BULU 6344. - IZMIT: Ulaşlı: Uzundere, under *Fagus* and *Castanea* forest, 580 m, 29.6.1991, BULU 636.
- A 3: IZMIT: Keltepe, under *Fagus* and *Castanea* forest, streambed and rocks, 760 m, 21.6.1990, O.Benlioğlu, BULU 4446. - BOLU: Tatova to Aband gölü road, 23 km, 1 km to Aband, mixed forest, on mossy tree-trunk near rocks, 1230 m, 22.9.1968, H.Demiriz, ISTF 26610 (Demiriz et all. 1969). - Kalkın, on wet rocks, 80 m, 29.9.1995, G.Tarımcılar, BULU 6390. - ZONGULDAK: Kızılcapınar: Sinitli village, in *Quercus* forest, rocks, 90 m, 30.9.1995, G.Tarımcılar, BULU 9398.
- \*\* A 4: KASTAMONU: between Ağlı And Cide, around Sada village, *Abies* forest, 920 m, 27.8.1994, G.Kaynak and G.Tarımcılar, BULU 9077. - Inebolu: Inebolu to Küre road, 5 km, damp rocks, 800 m, 27.8.1994, G.Kaynak and G.Tarımcılar, BULU 9063.
- A 5: SINOP: between Ayancık and Gökçeğaç, N slopes of Çangal Mo., under mixed forest (*Platanus*, *Acer*, *Ulmus*, *Quercus* ), 330 m, 26.8.1994, G.Kaynak and G.Tarımcılar, BULU 9024. - Ayancık: Zindan: between Kapıdağ and Atsökü, on damp places amongst calcareous rocks, 1220 m, B.Kasaplıgil (Demiriz et all. 1969). - Gerze: *Arbutus unedo* shrub, 400 m, 22.7.1992, F.Özen 1149 (Özen and Kılınç 1995).
- A 6: ORDU: Uzunisa: Arpaköy: Follak garden, on stone walls, 12.9.1967, S.Ates, ISTF 26047 (Demiriz et all. 1969). - Çambası yaylası, Terektas location, 2000 m, 20.5.1989, Karakaya 154 (Kılınç and Karakaya 1992).
- A 7: GİRESUN: Tamdere to Yavuzkema, nr. Karınca, 1500 m, D. 20748 (Davis 1965). - Giresun to Görele 7 km, roadside, damp rocks, 60 m, 26.8.1993, G.Kaynak and G.Tarımcılar, BULU 7800 (Kaynak and Tuyji 1994). - TRABZON: Maçka: Meryemana: Seslikaya, *Picea* forest, 1934, E.K.Balls et W.B.Gourlay 1653 (Davis 1965).
- A 8: ARTVIN: Arhavi: Dikyamaç village: Akıncılar quarter, roadside, on walls and stones, 25.7.1967, A.Kuru, ISTF 25646 a. - ARTVIN: 1950, H.Kayacık, ISTO 105 (Demiriz et all. 1969). - RİZE: Çamlık, 1300 m, 27.8.1993, G.Kaynak and G.Tarımcılar, BULU 7839. - Çamlıhemşin: Büyükköy, on walls, 30-50 m, 28.8.1993, G.Kaynak and G.Tarımcılar, BULU 7858. - Sarp: Kemalpaşa to Sarp, 5km, roadside, on damp rocks, 29.8.1993, G.Kaynak and G.Tarımcılar, BULU 7917. (Kaynak and Tuyji 1994).
- A 9: KARS: S Aygirsee, 2200 m, 81-63-15. (Sorger 1983).
- B 1: BALIKESİR: Edremit: Kaz Mo., streambed and rocks, 1000 m, 31.7.1987, O.Benlioğlu, BULU 6162. - Burhaniye: Madra Mo., Kılıktepe, *Pinus nigra* forest, rocks, 800 m, 10.7.1991, O.Benlioğlu, BULU 6228. - ÇANAKKALE: between Kalkın and Edremit, Hanlar Gedigi pass, under mixed forest, streambed, 600 m, 13.7.1991, O.Benlioğlu, BULU 6529.
- B 2: BALIKESİR: Dursunbey: Alaçam Mo., Candere pass, N slopes of Asartepe, rocky places, 900 m, 6.6.1987, O.Benlioğlu, BULU 6136. - Bigadiç: Ulus Mo., around Dağarcık, under *Fagus* forest, rocky places, 1200 m, 13.6.1987, O.Benlioğlu, BULU 6144. - BURSA: Inegöl: around Oylat thermal spring, under *Quercus* , *Fagus* forest, rocks, 700 m, 29.6.1988, G.Kaynak and O.Benlioğlu, BULU 3147.(Kaynak and Tuyji 1991) - M.Kemalpaşa: around Suuçtu, under *Pinus nigra* -*Fagus orientalis* forest, streambed and rocks, 680-700 m, 14.5.1990, O.Benlioğlu, BULU 4336. - between Tahtaköprü and Domanıç: Kocayayla, under *Fagus orientalis* forest, 1250 m, 6.7.1991, O.Benlioğlu, BULU 6211. - between Inegöl and Bozüyük: around Mezi village, under *Fagus* forest, 590 m, 13.6.1991, O.Benlioğlu, BULU 6309.
- C 6: HATAY: Dörtöyl: Topaktas yaylası: Amonos Mo., *Fagust* forest, 1350 m, 16.6.1967, Y.Akman. - Antakya: Harbiye, wet slopes, 300 m, 20.2.1955, H.Demiriz 2336 (Demiriz et all. 1969).

### *P. interjectum* Shivas

- A 1 (A): BALIKESİR: Marmara Peninsula: Manastır beach road, rocky slopes, 200 m, 25.6.1987, O.Benlioğlu, BULU 6450 (Kaynak and Tuyji 1991).
- A 2 (E): ISTANBUL: Sarıyer: Belgrad forest: Büyükbend, underwood, slope and edge of dam, 12.11.1967, H.Demiriz, ISTF 26056 (Demiriz et all. 1969).
- A 2 (A): ISTANBUL: Ömerli to Sile, 4km, under coppice-wood, 29.10.1966, H.Demiriz 6175.(Demiriz et all. 1969) - Kartal: Yakacık: Aydos Mo., in forest, valley, 500 m, 24.6.1992, O.Benlioğlu, BULU 6392.- BURSA: Gemlik: Armutlu: around Armutlu thermal spring, maquis, 110 m, 28.4.1988, G.Kaynak and O.Benlioğlu, BULU 2903 (Kaynak and Tuyji 1991). - Ulubat Gölü, Halibey adası, on rocks, 90 m, 25.9.1991, O.Benlioğlu, BULU 6374. - YALOVA: in vicinities of Esadiye village, in *Quercus* forest, 520 m, 20.2.1990, G.Kaynak and O.Benlioğlu, BULU 4215. - Termal: in forest, edge of river, 110 m, 24.6.1992, O.Benlioğlu, BULU 6387

- A 3: SAKARYA: Alifuatpasa to Adapazarı, 9 km, under rocks and *Paliurus* shrubs, 3.12.1966, H.Demiriz, ISTF 25023. - BOLU: Gümüşova to Hendek, 1 km, streamsides, damp slopes, 250 m, 30.4.1967, H.Demiriz, ISTF 25267 (Demiriz et al. 1969).- Yedigöller, in forest, shady damp rocks, 230 m, 28.8.1994, G.Kaynak and G.Tarımcılar, BULU 9156.
- \*\* A 4: KASTAMONU:** between Senpazar and Cide, mixed forest, 960 m, 27.8.1994, G.Kaynak and G.Tarımcılar, BULU 9108.
- A 7: TRABZON: between Trabzon and Bayburt, along rivulet rocks, 850 m, 26.8.1993, G.Kaynak and G.Tarımcılar, BULU 7809 A.(Kaynak and Tuyji 1994) - 3 km S of Hamsiköy, mixed forest of *Picea* and *Fagus*, with shrublayer of mainly *Carpinus*, *Corylus*, *Alnus*, *Ribes*, *Rhododendron*, 1900 m, 5.6.1959, Iter Leydenense 1847 (Demiriz et al. 1969).
- A 8: RIZE: Çaykara, near rivulet, damp rocks, 230 m, 27.8.1993, G.Kaynak and G.Tarımcılar, BULU 7812 (Kaynak and Tuyji 1994). - Arhavi: around Dikyamaç village, on walls and stones, 2000 m, 27.7.1995, O.Benlioğlu, BULU 7814 B.
- B 1: BALIKESİR: Balıkesir to İzmir, 35 km, Akçakırsak village, Arıtaskaya pass, on rocks, 450 m, 15.5.1987, O.Benlioğlu, BULU 6128. - Kaz Mo., streambed of Esek rivulet, rocks, 1000 m, 31.7.1987, O.Benlioğlu, BULU 6163 (Kaynak and Tuyji 1991). - IZMİR: between İzmir and Çesme, on a very rocky ridge, 21.3.1967, A.et T.Baytop, ISTE 10704. - Kemalpaşa, damp rocks in maquis, 1.5.1966, H.Pesmen 819 (Demiriz et al. 1969).
- B 2: BALIKESİR: Bigadiç: Ulus Mo., Dağarcık location, on rocks in *Fagus* forest, 1200 m, 13.6.1987, O.Benlioğlu, BULU 6145. - Dursunbey: Alaçam Mo., Candere pass, N slopes of Asartepe, rocks, 900 m, 6.6.1987, O.Benlioğlu, BULU 6137 (Kaynak and Tuyji 1991).- BURSA: between Inegöl and Oylat, around Hilmiye village, on high rocks, 670 m, 6.7.1990, O.Benlioğlu, BULU 6200. - KÜTAHYA: Kundören village: Sultan vineyards, 20.5.1967, B.Özaltın, ISTF 26022 (Demiriz et al. 1969).
- C 1: AYDIN: Kusadasi: Samsundağ: near locality Tasdelen, 8.5.1965, H.Kayacık et F.Yaltırık, ISTO 3362 (Demiriz et al. 1969).
- C 2: MUĞLA: Fethiye: near castle, in rock, 24.4.1964, C.Reyel (Demiriz et al. 1969).
- C 3: ANTALYA: 15 km SW of Antalya, NE Karadağ, SE slope of granite rock, with shrubs, soil rich in humus, 40 m, 7.4.1959, Iter Leydenense 137 (Demiriz et al. 1969).

***P. australe* Fée (= *P. tambricum* L.)**

- A 2 (E): ISTANBUL: Kireğburnu: around Kefeli suyu, damp slopes, 25.12.1966, H.Demiriz, ISTF 25038 (Demiriz et al. 1969).
- A 2 (A): ISTANBUL: Yakacık: above Ayazma, on rocks, 7.10.1968, H.Demiriz et T.Reichstein, ISTF 26731 (Demiriz et al. 1969). - Büyükkada: Ayayorgi hill, NE slopes, rocks, 120 m, 4.5.1991, O.Benlioğlu, BULU 6427. - Maltepe: Cevizli: Dragos hill, amongst rocks, 50 m, 5.5.1991, O.Benlioğlu, BULU 6180. - BURSA: Gemlik: Narlıca to Iznik, 2 km, roadside, open rocks, 80-90 m, 8.5.1992, O.Benlioğlu, BULU 6378. - Karacabey: Ballıkaya village, rocks, 130 m, 5.7.1992, O.Benlioğlu, BULU 6406.
- \*\* A 3: ADAPAZARI:** between Adapazarı and Geyve, around Nuruosmaniye village, under the forest and maquis, rocks, 50 m, 5.5.1991, O.Benlioğlu, BULU 6180.
- A 4: ZONGULDAK: Amasra: Akropol hill, summit, on rotten tree-trunks, on wet and damp places, 70 m, 22.2.1967, M.Durak, ISTF 25065 (Demiriz et al. 1969).
- A 5: SINOP: Hamsiloz limanı: N slopes of Deveci rivulet, 50 m, 30.5.1988, Karaer 061 (Karaer 1993).
- A 6: ORDU: Uzunnisa: Arpaköy: above quarter Cami yanı, on stone walls, 8.2.1967, S.Ates, ISTF 25048 (Demiriz et al. 1969).
- A 7: TRABZON: 8-10 km W of Akçaabat by Trabzon, Sauer. 189 (Demiriz et al. 1969). - Maçka: around Zigana pass, under *P. slyvestris* forest and on rocks, 2000 m, 26.7.1995, O.Benlioğlu, BULU 7812 B. - GİRESUN: Dereli, Tasocağı location, roadside, under *Corylus* plantation and shady places, 90 m, 25.8.1993, G.Kaynak and G.Tarımcılar, BULU 7758 B (Kaynak and Tuyji 1994).
- A 8: ARTVIN: Çoruh: Hopa, nr., D. 29877 (Davis 1965). - RIZE: Uzunkaya, 6.7.1947, A.Heilborn et Basarman (Demiriz et al. 1969).
- B 1: IZMİR: Gümlüdür, EGE 3190 (Gemici 1990). - ÇANAKKALE: Kazdağ: near Ayazma rivulet, rocks, 440 m, 12.7.1991, O.Benlioğlu, BULU 6242.
- C 1: IZMİR: 5 km SE Selçuk, 150 m, 82-11-43 (Sorger 1982).
- C 2: MUĞLA: Dereköy, between Marmaris and Muğla, 10 m, D. 25401 (Davis 1965).
- C 3: ANTALYA: Tekirova, 31.5.1950, M.Heilborn et A.Atilla. - Düdenbas (9 km N of Antalya): in 15 m deep canyon of the Düden çay, humid places, shaded, soil rich in lime, 40 m, 15.4.1959, Iter Leydenense 390. - Aksu: Toparlar Perge ruins: near Ağlarçayı, on stones, 24.2.1968, K.Kaymak, ISTF 26104 (Demiriz et al. 1969).



- C 6: ADANA: Between Haruniye and Karacaören: Karayar locality, edge of brook, on rocks, 10.2.1968, V.Ünal, ISTF 26097. - Iskenderun to Ceyhan, 57 km: Toprakkale ruins, on walls of ruins, 24.3.1967, H.Demiriz, ISTF 25169. - HATAY: Antakya, 2.1942, M.Basarman (Demiriz et al. 1969). - Osmaniye: Wagenitz 377 (Davis 1965)

## ASPLENIACEAE

### *Asplenium adiantum-nigrum* L.

- A 1 (E): KIRKLARELI: Demirköy, SE: slopes facing Değirmendere and valley, on rocks, 22.4.1967, H.Demiriz, ISTF 25235 (Demiriz et al. 1969).
- A 1 (A): BALIKESIR: Erdek: Kapıdağ, under maquis, 530 m, 18.7.1991, O.Benlioğlu, BULU 6367. - ÇANAKKALE: between Çan and Biga: around Emese village, on rocks in *Quercus* forest, 50 m, 12.7.1991, O.Benlioğlu, BULU 6251. - Çan to Yenice, 17 km, under *P. brutia* forest, streambed, 150 m, 12.7.1991, O.Benlioğlu, BULU 6253.
- A 2 (E): ISTANBUL: hill behind Çatalca, summit, on rocks fissures, 13.10.1966, A.Baytop et al., ISTF 10326 (Demiriz et al. 1969).
- A 2 (A): ISTANBUL: Büyükdada: NE slopes of Ayayorgi hill, rocks, 120 m, 4.5.1991, O.Benlioğlu, BULU 6425. - N slopes of Çamlıca hill, on rocks fissures, 150 m, 5.5.1991, O.Benlioğlu, BULU 6172. - YALOVA: in vicinities of Esadiye village, underwood, on rocks, 520 m, 20.2.1990, G.Kaynak and O.Benlioğlu, BULU 4212. - Termal: streamsides in forest, on rocks, 110 m, 24.6.1992, O.Benlioğlu, BULU 6388.
- A 3: ADAPAZARI: Akyazı: Pazarköy to Güzlek 3 km, 140 m, 10.5.1991, BULU 6191. - Geyve: Karaçam village, under mixed (*Fagus*, *Pinus*, *Quercus*) forest, on rocks, 240 m, 10.5.1991, O.Benlioğlu, BULU 6357.
- A 3: BOLU: Gümüşova to Hendek, 1 km, streamside, damp slopes, 250 m, 30.4.1967, H.Demiriz, B.Tutel, ISTF 25269 (Demiriz et al. 1969). - Yedigöller, underwood, on rocks fissures, 310 m, 28.8.1994, G.Kaynak and G.Tarımcılar, BULU 9171. - ZONGULDAK: 10 km, E von Zonguldak, 20 m, 283-59-11 (Sorger 1987).
- A 4: KASTAMONU: between Araç and Daday, on rocks, 900 m, 21.8.1994, G.Kaynak et G.Tarımcılar, BULU 8906. - Inebolu: Garten mauren, 17.4.1932, W.Kotte (Demiriz et al. 1969). - ZONGULDAK: Zonguldak to Kapis yolu, Besahet-Sazi 34 (Davis 1965).
- A 5: SINOP: N slopes of Boztepe Peninsula, 100 m, 19.7.1988, Karaer 448 (Karaer 1993).
- A 6: SAMSUN: 19 Mayıs: W edge of Fındıçak river, 25 m, 22.7.1991, Kutbay 705 (Kutbay 1995). - ORDU: Çamas: Güngören, roadside, rocks, 700 m, 24.8.1993, G.Kaynak et G.Tarımcılar, BULU 7740 (Kaynak and Tuyji 1994). - AMASYA: Borabay Lake, slopes, underwood, 1000 m, 15.8.1961, K.Karamanoğlu 684. nd
- A 7: GİRESUN: Yüceköy, roadside, on rocks, 970 m, 25.8.1993, G.Kaynak et G.Tarımcılar, BULU 7782. - TRABZON: between Trabzon and Bayburt, roadside, rocky slopes, 26.8.1993, G.Kaynak and G.Tarımcılar, BULU 7806 (Kaynak and Tuyji 1994).
- A 8: RİZE: Çamlıhemsin, roadside, rocky slopes, 520 m, 28.8.1993, G.Kaynak et G.Tarımcılar, BULU 7877. - ARTVIN: between Artvin and Borçka, roadside, rocks, 230 m, 29.8.1993, G.Kaynak et G.Tarımcılar, BULU 7903. - Sarp: Kemalpaşa to Sarp 5 km, roadside and rocky places, 25.8.1993, G.Kaynak et G.Tarımcılar, BULU 7919 A (Kaynak and Tuyji 1994).
- B 1: BALIKESIR: Burhaniye: Madra Mo., summit, rocks, 1200 m, 10.7.1991, O.Benlioğlu, BULU 6238. - ÇANAKKALE: Edremit to Ayvacık 10 km, under *P. brutia* forest, rocks, 350 m, 12.7.1991, O.Benlioğlu, BULU 6240.
- B 2: BURSA: Orhaneli, SW and SE of thermic power station, under oak thickets, 680-720 m, 26.5.1992, G.Kaynak et O.Benlioğlu, BULU 6380. - between Tahtaköprü and Domaniç: Kocayayla, under *P. nigra* forest, 1160 m, 6.7.1991, O.Benlioğlu, BULU 6213.
- \*\* B 3: AFYON: Sincanlı: Değirmendere location, streamside and rocks, 1300 m, 9.6.1995, O.Benlioğlu, BULU 9513.
- C 5: İÇEL: Silifke - Erdemli, 23 km, at the mouth of cavern, on rocks, 21.3.1967, H.Demiriz, ISTF 25135. - Tarsus: between Çoçak and Cehennemdere, 600-650 m, 8.7.1966, H.Esin (Demiriz et al. 1969).
- C 6: ADANA: Osmaniye: between Haraz and Yarpuz: Amonos Mo., under *P. brutia* forest, 800 m, 30.9.1966, Y.Akman 3032 (Demiriz et al. 1969).

### *A. onopteris* L.

- A 1 (E): KIRKLARELI: Demirköy, SE: Değirmendere, streamside, 22.4.1967, H.Demiriz ISTF 25239 (Demiriz et al. 1969).
- A 1 (A): BALIKESIR: Erdek: Kapıdağ, under maquis, 530 m, 18.7.1991, O.Benlioğlu, BULU 6366. - ÇANAKKALE: Gökçeada: screes of Tepeköy, rocks, 200 m, 2.6.1989, O.Benlioğlu, BULU 6252 (Kaynak and Tuyji 1991).

- A 2 (E): ISTANBUL: Belgrad forest, underwood, slopes and edge of dam, 12.11.1967, H.Demiriz, ISTF 26055 (Demiriz et.al 1969).
- A 2 (A): ISTANBUL: Kartal: Cevizli: Dragos hill, on rocks, 50 m, 5.5.1991, O.Benlioğlu, BULU 6181. - YALOVA: between Orhangazi and YALOVA: around Esadiye village, on rocks, 520 m, 20.2.1990, G.Kaynak et G.Tarımcılar, BULU 4214. - BURSA: Armutlu: around Cumalıköy, maquis, 410 m, 16.7.1987, G.Kaynak et O.Benlioğlu, BULU 2673 (Kaynak and Tuyji 1991). - Uludağ: Kirazlıyayla, roadside, under *Abies* forest, 1100 m, 23.5.1991, O.Benlioğlu, BULU 6369. - IZMIT: Akçaova to Ağva, 8 km, roadside, under *Quercus* plantation, rocks, 100 m, 20.6.1990, O.Benlioğlu, BULU 4426.
- A 3: ADAPAZARI: between Adapazarı and Geyve: around Nuruosmaniye village, underwood, rocks, 160 m, 22.6.1990, O.Benlioğlu, BULU 4433. - IZMIT: Keltepe, under *Sambucus* plantation, 580 m, 21.6.1990, O.Benlioğlu, BULU 4431. - ZONGULDAK: Ereğli: around Bağlık, shrubs, 29.8.1965, F.Yaltırık, ISTO 4459. - BOLU: Yedigöller, underwood, on rocks, 310 m, 28.8.1994, G.Kaynak et G.Tarımcılar, BULU 9177. - Kalkın, roadside, on rocks, 80 m, 29.9.1995, G.Tarımcılar, BULU 9391.
- A 4: ZONGULDAK: Amasra: N slopes Akropol hill, area surrounded by *Laurus* and *Rubus*, 50 m, 21.2.1967, M.Durak, ISTF 2505 (Demiriz et all. 1969). - Bartın: Kurucasile, roadside, on rocks, 28.8.1994, G.Kaynak et G.Tarımcılar, BULU 9143. - KASTAMONU: between Senpazar and Cide, mixed forest, 890 m, 27.8.1994, G.Kaynak et G.Tarımcılar, BULU 9119.
- A 5: SINOP: between Ayancık and Gökçeada, N slopes of Çangal Mo., under mixed forest, 330 m, 26.8.1994, G.Kaynak and G.Tarımcılar, BULU 26.8.1994.
- A 6: ORDU: Uzunisa: Arpaköy: Follak garden, on stone walls, 8.9.1967, S.Ates, ISTF 26045 (Demiriz et all. 1969).
- A 7: GİRESUN: Dereli, damp rocks, 140 m, 25.8.1993, G.Kaynak et G.Tarımcılar, BULU 7761. - Görele to Tirebolu, 7 km, roadside, rocks, 60 m, G.Kaynak et G.Tarımcılar, 26.18.1993, BULU 7800 (Kaynak and Tuyji 1994).
- A 8: RİZE: İkizdere: Güneyce, streambed, on rocks in *Corylus* plantation, 350 m, 27.8.1993, G.Kaynak et G.Tarımcılar, BULU 7829. - ARTVIN: between Artvin and Borçka, roadside, rocks, 230 m, 29.8.1993, G.Kaynak et G.Tarımcılar, BULU 7904. - Sarp: Kemalpaşa to Sarp, 5 km, roadside, on rocks, 29.8.1993, G.Kaynak et G.Tarımcılar, BULU 7919 (Kaynak and Tuyji 1994).
- B 1: BALIKESİR: Edremit: Kazdağ, streambed of Ayı deresi, rocks, 900 m, 31.7.1987, O.Benlioğlu, BULU 6231 (Kaynak and Tuyji). - Burhaniye: SW slopes of Madra Mo., under granite rocks, 900 m, 10.7.1991, O.Benlioğlu, BULU 6247. - ÇANAKKALE: between Kalkın and Edremit: Hanlar Gediği pass, under mixed forest, 600 m, 13.7.1991, O.Benlioğlu, BULU 6257.
- B 2: BALIKESİR: Bigadiç: Ulus Mo., Dağarcık location, on serpentine rocks, 750 m, 13.6.1987, O.Benlioğlu, BULU 6146. - Alaçam Mo., Candere pass, Gavrur hill, rocks, 1000 m, 6.6.1987, O.Benlioğlu, BULU 6134 (Kaynak and Tuyji 1991). - BURSA: Mustafakemalpaşa: around Suuçtu, under *Fagus*, *Pinus* forest, rocks, 680-700 m, 14.5.1990, O.Benlioğlu, BULU 4332. - Inegöl: Mezit 7, under *Fagus* forest, 690 m, 13.6.1991, O.Benlioğlu, BULU 6313.
- \*\* B 3: AFYON: Çakır village, rocks, 1200 m, 18.6.1995, O.Benlioğlu, BULU 9514.**
- C 1: IZMİR: Selçuk: Meryemana, maquis, 29.7.1966, H.Pesmen 1200. - AYDIN: Kusadası: Kalamaki deresi, maquis, 30.7.1965, H.Pesmen 1199 (Demiriz et all. 1969).
- C 2: AYDIN: Bozdoğan: Madran Mo., *P. brutia* forest, 28.9.1966, H.Pesmen 1204 (Demiriz et all. 1969).
- C 3: ANTALYA: Kesme: Boğaz, nr, Kemer, D. 14047 (Davis 1965).
- C 4: IÇEL: Kükür to Sarıdanı, 500 m, D. 16324 (Davis 1965). - ANTALYA: Alanya: Deretürbanaz yaylası. 24.2.1966, A.et T.Baytop, ISTE 8538. - IÇEL: Anamur to Gazipasa, 16 km, *Pinetum*, streamside, 27.9.1968, H.Demiriz, ISTF 26670 (Demiriz et all. 1969).
- C 5: IÇEL: 20 km W of Mersin, E slopes, with open pine forest and shrub-vegetation, 600 m, 14.4.1959, İter Leydenense, 1148 (Demiriz et all. 1969).
- C 6: MARAS: Ardırın: around Boynuyoğunlu village, M.Kayna, 19.7.1951. - ADANA: Kadırlı: Menkiliçköy, around steep rivulet, 20.7.1951, S.Düldül. - HATAY: Dörtöyl: Kuzuculu to Büke on forest road, limestone rocks and wet leaf-mould, 1000 m, 4.5.1965, M.J.E. Coode et B.M.G. Jones 415. - Antakya: road to lake, 1.2.1942, M.Basarman (Demiriz et all. 1969).
- A. septentrionale** (L.) Hoffm. subsp. **caucasicum** Fraser-Jenkins et Lovis
- \*\* A 7: TRABZON: Zigana pass. *P. sylvestris* forest, rocks, 2000 m, 26.7.1995, O.Benlioğlu, BULU 9488.**
- A 8: TRABZON: N of Bayburt: above Çaykara, Soğanlı Mo., pass, 1500 m, Jenkins 4063 (Jenkins 1980). - between Çaykara and Bayburt: above Atabey, under *Picea* forest, on rocks fissures, 660 m, 28.7.1995, O.Benlioğlu, BULU 9119 A. - Soğanlı Mo., pass, N slopes, on rocks fissures, 2000 m, 28.7.1995, O.Benlioğlu, BULU 9119 B.
- A. ruta-muraria** L. subsp. **ruta-muraria**
- A 2 (E): ISTANBUL: Belgrad forest, on walls of aqueduct, 1.1.1967, H.Demiriz, ISTF 25040 (Demiriz et all.1969).



- A 2 (A): ISTANBUL: between Ağva and Sile: around Ubeyli, maquis, rocks, 190, 20.6.1990, O.Benlioğlu, BULU 4428. - BURSA: Uludağ: above Yiğitalı village, on rocks, 580 m, 30.4.1991, O.Benlioğlu, BULU 6421. - Yenisehir: Avdan Mo., on rocks in maquis, 640 m, 29.6. 1991, O.Benlioğlu, BULU 6345.
- \*\* A 3:** BOLU: 12 km from Bolu to Yeniçağ, under the *P. nigra* forest, rocks, 790 m, 24.7.1995, O.Benlioğlu, BULU 9504. - BİLECİK: 5 km from Bilecik to Osmaneli, under the *P. nigra* forest, rocks, 390 m, 13.6.1991, BULU 6430.
- A 4: BOLU: Kızılcahamam to Gerede, 44 km, Yenicek çayı, limestone rock and stony slope, 1230 m, 22.9.1968, H.Demiriz, ISTF 26615. - ANKARA: Çubuk, 8.1947, H.Bağda 1136 (Demiriz et al. 1969). - ZONGULDAK: Keltepe, 1700 m, D. 37895 (Davis 1965).
- A 5: KASTAMONU: crossroad to Cide, rocky and stony places, 1050 m, 27.8.1994, G.Kaynak et G.Tarımcılar, BULU 9072. - Ilgaz Mo., open places in *Abies* forest, on rocks fissures, 1865 m, 24.7.1995, O.Benlioğlu, BULU 9511 B.
- A 6: ORDU: Bolaman to Yalıköy, 20 km, 10.8.1991, Karaer 1030 (Karaer 1993).
- A 8: GÜMÜSHANE: Gümüşhane, 1800 m, Balls 1731 / 1934. - ARTVIN: Çoruh: nr. Artvin (Davis 1965).
- A 9: ARTVIN: Çoruh: nr. Ardanuç (Davis 1965).
- B 2: BURSA: Harmancık: Harmancık to Dedeali, 3 km, steep slopes, 700 m, 8.7.1992, O.Benlioğlu, BULU 6412. - KÜTAHYA: Murat Mo., Akçakaya location, 1200 m, 2.5.1977, A.Çırpıcı 30309 (Çırpıcı 1979).
- B 3: BİLECİK: between Bilecik and Bozüyük: Demirköy, stony and rocky places exposed to the sun, 650 m, 13.6.1991, O.Benlioğlu, BULU 6317. - ISPARTA: Uluborlu: Kapıdağ, Ayçilesi location, 1900 m, 28.7.1995, G.Kaynak, BULU 9485.
- B 4: ANKARA: Dikmen, Walter 1216 (Davis 1965).
- B 7: TUNCELI: Tunceli to Ovacık, 16 km, Munzur valley, rocks, 970 m, 20.6.1979, G.Kaynak, DUF 2828 (Kaynak 1980).
- B 8: DIYARBAKIR: Lice: Abalı, around caves of Birklin, rocks and at the mouth of cavern, 870-920 m, 31.7.1976, H.Demiriz, DUF 925 (Demiriz et Kaynak 1977). - ERZURUM: Meczetli, Saposhnikov et Schischkin (Davis 1965).
- C 3: ANTALYA: Bozburun Mo., 1600 m., D. 15517 (Davis 1965). - Gürleyik Yaylası, 7.1949, A.Atila (Demiriz et al. 1969).
- C 5: İÇEL: Gülek pass, steep rocks, 1050-1200 m, 25.9.1968, H.Demiriz, ISTF 26654 (Demiriz et al. 1969).
- C 6: ADANA: Haruniye: Kurtlar castle, on walls, 6.8.1968, V.Ünal, ISTF 26737 (Demiriz et al. 1969). - KAHRAMANMARAS: Engizek Mo., around Küçükyesil yaylası, 2100-2300 m, Duman 3613 (Duman 1991).
- A. scolopendrium* L. subsp. *scolopendrium***
- A 1 (E): Kırklareli: Demirköy: Balaban village, stony river-bed and its surrounding, 420 m, 21.4.1967, H.Demiriz, ISTF 25229 (Demiriz et al. 1969).
- \*\* A 1 (A):** BALIKESİR: Erdek: Kapıdağ, under the *Fagus* and *Castanea* forest, 370 m, 18.7.1991, O.Benlioğlu, BULU 6260.
- A 2 (A): BURSA: Uludağ: Kestel: Sevketiye to Sayfiye, 3 km, under *Fagus* forest, valley and rocky slopes, 900 m, G.Kaynak et O.Benlioğlu, BULU 2925.
- A 3: İZMİT: under growth in *Fagus* and *Castanea* forest, damp rocks, 760 m, 21.6.1990, BULU 4432. - BOLU: Yedigöller, under mixed forest, 230 m, 28.8.1994, G.Kaynak et G.Tarımcılar, BULU 9158. - ZONGULDAK: Zonguldak to Devrek, 3,5 km, roadside and edge of forest, damp underwood, 140 m, 21.6.1951, H.Demiriz 574 (Demiriz et al. 1969).
- A 4: ZONGULDAK: Amasra: :S, road to Akropol hill, roadside, damp places, 60 m, 22.2.1967, M. Durak, ISTF25061 (Demiriz et al. 1969). - KASTAMONU: Sarpazar to Cide, 20 km, under *Fagus* and *Abies* forest, 850 m, 27.8.1994, G.Kaynak et G.Tarımcılar, BULU 9101. - Bartın: Kurucasile, damp places, 28.8.1994, G.Kaynak et G.Tarımcılar, BULU 9139.
- A 5: SİNOP: between Ayancık and Gökçeada, screes of Çangal Mo., under mixed forest, 330 m, 26.8.1994, G.Kaynak et G.Tarımcılar, BULU 9027.
- A 6: ORDU: Çamas: in vicinities of Tepeli village, shady places, 400 m, 24.8.1993, G.Kaynak et G.Tarımcılar, BULU 7728 (Kaynak and Tuyji 1994). - Fatsa: above Kayalar De., 60 m, Tobay 60 (Davis 1965).
- A 7: GİRESUN: Gönüllü village, under *Corylus* plantation, 170 m, 26.8.1993, G.Kaynak et G.Tarımcılar, BULU 7789 (Kaynak and Tuyji 1994). - TRABZON: 23 km, WNW of TRABZON, humid slope, along rivulet, shaded, 5 m, 4.6.1959, İter Leydenense 1765 (H.Demiriz et al. 1969).

- A 8: RIZE: Çaykara, streamside, damp rocks, 430 m, 27.8.1993, G.Kaynak and G.Tarımcılar, BULU 7821. - Çamlık, damp rocks, 1300 m, 27.8.1993, G.Kaynak et G.Tarımcılar, BULU 7821. - ARTVIN: between Artvin and Borçka, wet rocks, 670 m, 29.8.1993, G.Kaynak et G.Tarımcılar, BULU 7810. - Sarp: Kemalpaşa to Sarp, 5 km, roadside, on rocks, 29.8.1993, G.Kaynak et G.Tarımcılar BULU 7916 (Kaynak and Tuyji 1994).
- B 1: BALIKESİR: Edremit: Kazdağı, streambed, rocks, 1000 m, 31.7.1987, O.Benlioğlu, BULU 6165 (Kaynak and Tuyji 1991). - ÇANAKKALE: Evciler: Kazdağı, Ayazma rivulet, on rocks in *P. nigra* forest, 450 m, 12.7.1991, O.Benlioğlu, BULU 6245.
- B 2: İnegöl: Oylat: around thermal spring, under *Fagus* and *Quercus* forest, rocks, 590 m, 29.6.1988, G.Kaynak et O.Benlioğlu, BULU 3142. - around Mezit village, on rocks in streambed, under *Fagus* forest, 500 m, 13.6.1991, O.Benlioğlu, BULU 6310.
- B 7: TUNCELİ: Munzur Mo., above Ovacık, 2100 m, D. 31318 (Davis 1965).
- B 8: Diyarbakır: Eğil: Eğil castle, bottom of cistern, 25.5.1980, G.Kaynak, DUF 2665 (Kaynak 1980).
- C 3: ANTALYA: Gönük De., E side of Ak Mo., 1000 m, D. 14289 (Davis 1965).
- C 6: HATAY: Dörtöy: towards Mingır hill, 5.1950, I.Akbas, ISTO 100. - İSKENDERUN: Köstelli: Amonos Mo., *Fagus* forest, 1500 m, 26.7.1966, Y.Akman 3556 (Demiriz et al. 1969).

### A. *ceterach* L. subsp. *ceterach*

- A 1(A): BALIKESİR: Balya: Orhanlar village, on rocks, 550 m, 19.6.1987, O.Benlioğlu, BULU 6148. - Erdek: S side of Erdek, under *P. brutia* forest, rocky place, 50 m, 19.5.1987, O.Benlioğlu, BULU 6149. - Marmara Adası, Altınsuyu sprig road, rock places, 300 m, 25.6.1987, O.Benlioğlu, BULU 6152 (Kaynak and Tuyji 1991). - Çanakkale: between Çan and Biga: around Katrancı village, on rocks in *Quercus* forest, 50 m, 12.7.1991, O.Benlioğlu, BULU 6250.
- A 2 (E): İSTANBUL: Belgrad forest: around Kirazlı bend, on walls, 9.5.1968, H.Demiriz ISTF 26328 (Demiriz et al. 1969).
- A 2 (A): Kartal: Yakacık Mo., on rocks in *P. nigra* forest, 350 m, 26.6.1992, O.Benlioğlu, BULU 6398. - BURSA: İnegöl: Uludağ: above Merzuke village, rocks, 1200 m, G.Kaynak et O.Benlioğlu, 7.5.1987, BULU 1917. - Orhangazi: between Orhangazi and Hamzalı, maquis, 16.7.1987, G.Kaynak et O.Benlioğlu, BULU 2675. - Gemlik: Sahintepe, maquis, rocks, 600 m, 9.6.1989, G.Kaynak et O.Benlioğlu, BULU 6184. - Gemlik: Kapaklı, valley, on rocks in *Quercus* and *Acer* forest, 30-40 m, 6.7.1988, G.Kaynak et O.Benlioğlu, BULU 3186 (Kaynak and Tuyji 1991). - Yenisehir: around Seymen village, rocks, 450 m, 21.5.1987, G.Kaynak, 29.6.1991, BULU 1979. - Iznik: Iznik to Adapazarı, 18 km, around Kayadin village, rocks, 240 m, 9.5.1991, O.Benlioğlu, BULU 6185. — Ulubat Gölü: Halil bey adası, on rocks, 25.9.1991, O.Benlioğlu, BULU 6342. - Karacabey: around İnka village, on rocks, 150 m, 5.7.1992, O.Benlioğlu, BULU 6401. - YALOVA: around Eşadiye village, on rocks, 520 m, 20.2.1990, G.Kaynak et O.Benlioğlu, BULU 4210. - İZMİR: between Ulaş and Osmaniye, on rocks, in maquis, 250 m, 29.6.1991, O.Benlioğlu, BULU 6327.
- A 3: ADAPAZARI: in vicinities of Mekece, on rocks, 140 m, 9.5.1991, O.Benlioğlu, BULU 6186. - BİLEÇİK: Boğaz to Demirköy, 5 km, rocky places, 500 m, 21.5.1987, G.Kaynak, BULU 2003. - Vezirhan to Gölpazarı, 3 km, steep rocks, 190 m, 13.6.1991, O.Benlioğlu, BULU 6319. - BOLU: Eğerci: Yedigöller, on rocks in shady place, 250 m, 28.8.1994, G.Kaynak et G.Tarımcılar, BULU 9153.
- A 4: KASTAMONU: between Ağıl and Cide, rocks, 1050 m, 27.8.1994, G.Kaynak et G.Tarımcılar, BULU 9073. - İnebolu: on walls, H.Birand (Demiriz et al. 1969).
- A 5: SİNOP: Durağan: around Yukarı Çerkezler village, S, *Phillyrea latifolia* bushes, dry habitat, 250 m, 20.7.1992, Özen 1125 (Özen and Kılınç 1995). - Boztepe Peninsula: W side of graveyard, 50-100 m, 23.6.1988, Karaer 292 (Karaer 1993). - between Saraydüzü and Kargı, under *Pinus* forest, 320 m, 24.8.1994, G.Kaynak et G.Tarımcılar, BULU 8971. - ÇORUM: Osmancık: around Eymir village, waterside, 420 m, 24.8.1994, G.Kaynak et G.Tarımcılar, BULU 8980. - KASTAMONU: Tosya, around Karaköy, 450 m, 15.7.1976, Kılınç 5029 (Kılınç 1985).
- A 6: AMASYA: Amasya to Erzincan road, 10 km, on rocks, 385 m, 25.8.1994, G.Kaynak et G.Tarımcılar, BULU 8992.
- \*\* A 7: TRABZON: between Çaykara and Bayburt, above Atabey, under forest, 660 m, 28.7.1995, O.Benlioğlu, BULU 9506.
- A 8: Çoruh: nr Artvin (Davis 1965).
- A 9: Çoruh: nr Ardahan (Davis 1965).
- B 1: BALIKESİR: Burhaniye: Madra Mo., Kılık hill, on rocks in *P. nigra* forest, 800 m, 10.7.1991, O.Benlioğlu, BULU 6229. - Edremit: Kaz Mo., rocks, 500 m, 31.7.1987, O.Benlioğlu BULU 6164 A



- (Kaynak and Tuyji 1991). - IZMİR: Yamanlar Mo., Karagöl, 22.3.1967, A.Et T.Baytop, ISTE 10726. - Kemalpaşa: Nif Mo., 24.5.1965, R.Bulut. - MANİSA: foot of Manisa Mo., behind casino, 20.3.1967, A.et T.Baytop, ISTF 1068 (Demiriz 1969).
- B 2: BALIKESİR: Sındırgı: Emendere thermal spring, edge of rivulet, on rocks, 600 m, 5.7.1987, O.Benlioğlu, BULU 6157 (Kaynak and Tuyji 1991). - BURSA: Inegöl: between Inegöl and Oylat: around Hilmiye village, rocks, 580 m, 6.7.1991, O.Benlioğlu, BULU 6201. - Tunçbilek to Harmancık, 20 km, on rocks in *P. nigra* forest, 850 m, 6.7.1991, O.Benlioğlu, BULU 6216. - Harmancık: Harmancık to Dursunbey, 6 km, rocks, 700 m, 8.7.1992, O.Benlioğlu, BULU 6409. - KÜTAHYA: Domaniç: Domaniç to Tunçbilek, 10 km, roadside, on rocks, 750 m, 6.7.1991, O.Benlioğlu, BULU 6419. - Murat Mo., Kapsıca location, 1400 m, 13.8.1977, A.Çırpıcı 31025 (Çırpıcı 1989).
- \*\* B 3: ISPARTA: Uluborlu: Kapıdağ, Akçay location, valley, stony and rocky places, 1200 m, 19.7.1995, G.Kaynak, BULU 9486. - Eğirdir: Yazılı Canyon, on rocks of canyon, 16.8.1994, G.Kaynak, BULU 9518. - AFYON: Sandıklı, Basağaç pass, rocks, 1400 m, 4.6.1995, O.Benlioğlu, BULU 9512. - BİLECİK: Bozüyük, rocky places exposed to the sun, 900 m, 15.5.1991, O.Benlioğlu, BULU 6368.**
- B 4: ANKARA: Bala to Kaman, 33 km: near Kprüköyü: beside Kızılırmak, granite rocks, 730 m, 23.9.1968, H.Demiriz, ISTF 26629 (Demiriz et al. 1969).
- B 7: TUNCELİ: Tunceli to Ovacık, 16 km, Munzur valley, rocks, 970 m, 20.6.1979, G.Kaynak, DUF 2841 (Kaynak 1980). - DIYARBAKIR: Ergani to Maden, 8 km, gorge, rocky and stony slopes, 30.3.1975, H.Demiriz and Ö.Saya, DUF 53 (Kaynak 1989).
- B 8: DIYARBAKIR: Lice: Abalı, around caves of Birklin, rocks and at the mouth of cavern, 870 -920 m, 31.7.1976, H.Demiriz, DUF 926. - SIİRT: Baykan: Baykan to Bitlis, 5 km, valley, rocks, 820 m, 19.6.1976, H.Demiriz et G.Kaynak, DUF 589. - BITLİS: Baykan to Bitlis, 7 km, valley, rocks, 850 m, 19.6.1976, H.Demiriz and G.Kaynak, Duf 596 (Demiriz and Kaynak 1977).
- B 9: BITLİS: Bitlis to Baykan, 9,5 km, near rivulet, rocks, 1280 m, 21.5.1978, G.Kaynak, DUF 1653 (Kaynak 1989).
- C 1: AYDIN: Samsun Mo., 420 m, D. 34954. - IZMİR: Selçuk: Efes ruins, on rocks, 15.9.1967, M.Önder et H.Kayacık, ISTO 6050. - MUĞLA: Prope Milas, in rupestres, 12.5.1965, C.Regel (Demiriz et al. 1969).
- C 2: MUĞLA: Yatağan: beside Söğütçük rivulet, on rocks, 24.2.1957, T.Baytop, ISTE 4961. - Fethiye: between Göcek and Gökçeovacık, in *Pineto brutiae alpino*, 20.1.1965, C.Regel. - Denizli: Tavas: near Ibiskahvesi: Karamanlar, 23.3.1957, M.Heilborn (Demiriz et al. 1969).
- C 3: BURDUR: Burdur to Çeltikçi, 20 km: N side Çeltikçibeli pass, rocks, 1200-1250 m, 28.9.1968, H.Demiriz, ISTF 26686. - Duraliler village: around Tat gölü, on rocks, 24.3.1967, S.Dallı, ISTF 25201. - ANTALYA: Aspendos ruins, amongst walls of ruins, 24.2.1968, K.Kaymak, ISTF 26102. - Manavgat: Murdici, 26.3.1967, A.et T.Baytop, ISTE 10763 (Demiriz et al. 1969). - KONYA: between Beyselir and Akseki, 29.4.1956, A.Atila (Demiriz et al. 1969).
- C 4: ANTALYA: Alanya, on hill with castle, 14.4.1965, A.et T.Baytop, ISTE 7660. - İÇEL: Anamur to Gazipasa, 3,5 km, *Pinetum*, rocks, 450 m, 27.9.1968, H.Demiriz, ISTF 26672. - Mut to Silifke, 32 km, amongst rocks, 20.3.1967, H.Demiriz, ISTF 25107 (Demiriz et al. 1969).
- C 5: İÇEL: Silifke to Erdemli, 12 km, on rocks, 20 m, 21.3.1967, H.Demiriz, ISTF 25131. - Mersin: E ridges of Fındıklıpınarı, stony ridges, mixed forest, 1250 m, 28.5.1951, H.Demiriz 455. - Gülek pass, on rocks, 1050 m, 25.3.1967, H.Demiriz, ISTF 25170. - NIĞDE: Çiftelhan to Ulukışla, 5 km, on rocks, 25.3.1967, H.Demiriz, ISTF 25174. - ADANA: Pozanti: above Sekerpınarı: Asmacık location, mixed forest, rocky, stony slopes, 1300 m, 25.9.1968, H.Demiriz, ISTF 26651. - HATAY: Antakya: Musa Mo., 700 m, 14.4.1967, Y.Akman (Demiriz et al. 1969).
- C 6: KAHRAMANMARAS: Engizek Mo., Dehliz Yurdu location, on rocks fissures, 1500-1700 m, 23.4.1987, Duman 2548 (Duman 1991). - ADANA: Haruniye: near castle of Kurtlar, in stone crevices, 6.8.1968, V.Ünal, ISTF 26736. - İSKENDERUN: Ceyhan, 57 km: Toprakkale ruins, on walls of ruins, 24.3.1967, H.Demiriz, ISTF 25168. - Osmaniye: between İncebel and Yarpuz: Amonos Mo., under *P. brutia* forest, 850 m, 30.9.1966, Y.Akman 3050. - HATAY: Dörtöl: Amanos Da.: between Kapılı and Çat köyü, 600-1000 m, 12.10.1951, I.Akbas, ISTO 312. - Dörtöl: Rabat, conglomerate rock in river, 5.5.1965, M.J.E. Coode et B.M.G. Jones 469. - Antakya: 1 km to Belen, rocks, 24.3.1967, H.Demiriz, ISTF 25161 (Demiriz et al. 1969). - Seyhan: Bahçe: Dumanlı Mo., 1300 m, D. 26853 (Davis 1965). - Gaziantep: Gaziantep to Bahçe, 47 km.: Sof Mo., rocky slopes, 26.3.1975, H.Demiriz, DUF 33 (Demiriz and Kaynak 1977).
- C 7: ADIYAMAN: Kahta: Kahta to Damlacık, 1,5 km: Cendere bridge, valley, rocks, 10.6.1978, G.Kaynak, DUF 1774 (Kaynak 1980).
- C 8: DIYARBAKIR: Çınar: Diyarbakır to Çınar, 20 km: across T.R.T. transmitter, rocks, 25.4.1978,

G.Kaynak, DUF 1515. - MARDIN: Savur: Mardin to Savur, 40 km, rocks, 10.3.1979, H.Malyer, DUF 2101 (Kaynak 1989). - SIIRT: Kurtalan: Kurtalan to Siirt, 8,5 km, rocks, 780 m, 3.4.1976, H.Demiriz et G.Kaynak, DUF 443 (Demiriz and Kaynak 1977).

## ATHYRIACEAE

### *Athyrium filix-foemina* (L.) Roth

- A 1 (E): Kırklareli: Mahya Mo., 800 m, 12.6.1968, A.Baytop et B.Çubukçu, ISTE 13281. - Demirköy: around Velika bridge, 24.6.1960, H.Kayacık, ISTO 812 (Demiriz et all.1969).
- A 1(A): BALIKESİR: Erdek: Kapıdağ, under *Fagus* forest, 560 m, 18.7.1991, O.Benlioğlu, BULU 6264. - Marmara Adası, waterside, rocky places, 40 0 m, 25.6.1987, O.Benlioğlu, BULU 6446 (Kaynak and Tuyji 1991).
- A 2 (E): ISTANBUL: Belgrad forest: around Kamer suyu, underwood, edge of water, 27.10.1966, H.Demiriz 6164 (Demiriz et all. 1969).
- A 2 (A): ISTANBUL: Polenezköy, under *Fagus* forest, 250-280 m, 5.5.1991, O.Benlioğlu, BULU 6175. - BURSA: Uludağ: 7 km to National park, under *Fagus* forest, 950 m, 30.7.1991, O.Benlioğlu, BULU 6302. - Gemlik: Armutlu: around Cumalı village, maquis, 410 m, 5.4.1989, G.Kaynak et O.Benlioğlu, BULU 4084 (Kaynak and Tuyji 1991). - IZMIT: Ulaşlı: Uzundere, under *Fagus* and *Castanea* forest, rocky places, 580 m, 29.6.1991, O.Benlioğlu, BULU 6331.
- A 3: ADAPAZARI: Akyazı: Pazarköy to Gülek, 3 km, 140 m, 10.5.1991, O.Benlioğlu, BULU 6187. - IZMIT: Düzce to Akçokoca, Walter et Bilger, 4619 (Davis 1965). - Keltepe, under *Fagus* and *Castanea* forest, on wet rocks in streambed, 760 m, 21.6.1990, O.Benlioğlu, BULU 4435. - BOLU: Yedigöller, under mixed forest, 310 m, 28.8.1994, G.Kaynak et G.Tarımcılar, BULU 9174.
- A 4: KASTAMONU: between Kastamonu and Tosya, near rivulet, 880 m, 21.8.1994, G.Kaynak et G.Tarımcılar, BULU 8948. - between Senpazar and Cide, in mixed forest, 890 m, 27.8.1994, G.Kaynak et G.Tarımcılar, BULU 9112. - Bartın: around Karaman, maquis, 28.8.1994, G.Kaynak et G.Tarımcılar, BULU 9142. - ZONGULDAK: Simsir De., above Yenice, 780 m, D. 37827 (Davis 1965).
- A 5: SİNOP: Ayancık: Çangal Mo., 1090 m, 26.8.1994, G.Kaynak et G.Tarımcılar, BULU 9044. - ÇORUM: Kargı: Köse Mo., in *P. slyvestris* forest, 1600 m, 15.7.1976, Kılınç 5036 (Kılınç 1985).
- A 6: ORDU: Çamas, under *Corylus* plantation, 490 m, 24.8.1993, G.Kaynak et G.Tarımcılar, BULU 7733. - Gülyalı: Kestane köyü: under *Corylus* plantation, 490 m, 24.8.1993, G.Kaynak et G.Tarımcılar, BULU 7733. - Gülyalı: Kestane köyü: under *Corylus* plantation, 200 m, 27.9.1995, O.Benlioğlu, BULU 9518.
- A 7: GİRESUN: Tamdere to Yavuzkema, 1500 m, D. 20763 (Davis 1965). - Yüceköy, roadside, 970 m, 25.8.1993, G.Kaynak et G.Tarımcılar, BULU 7780 (Kaynak and Tuyji 1994). - TRABZON: Maçka to Meryemana, 16 km, mixed forest (*Pinus*, *Alnus*, *Carpinus*), 13.7.1966, H.Demiriz 5700 A (Demiriz et all. 1969).
- A 8: RİZE: Çaykara, streamside, damp rocks, 230 m, 27.8.1993, G.Kaynak et G.Tarımcılar, BULU 7810. - İkizdere: Güneyce, under *Corylus* plantation, rocks, 350 m, 27.8.1993, G.Kaynak et G.Tarımcılar, BULU 7826. - Çamlıhemsin, roadside, rocky slopes, 520 m, 28.8.1993, G.Kaynak et G.Tarımcılar, BULU 7873. - ARTVIN: between Artvin and Borçka, wet rocky slopes, 230 m, 29.8.1993, G.Kaynak et G.Tarımcılar, BULU 7905. - Sarp: Kemalpaşa to Sarp, 5 km, roadside, rocks, 29.8.1993, G.Kaynak et G.Tarımcılar, BULU 7921 (Kaynak and Tuyji 1994).
- A 9: KARS: near Ardahan (Grossheim 1:map 24) (Davis 1965).
- B 1: BALIKESİR: Burhaniye: SW slopes of Madra Mo., valley, amongst granite rocks, 950 m, 10.7.1991, O.Benlioğlu, BULU 6232. - Edremit: Kaz Mo., around Çeyizdere, 1300 m, 31.7.1987, O.Benlioğlu, BULU 6447 A. - ÇANAKKALE: between Kalkım and Edremit: Hanlar Gediği pass, under mixed forest, streambed, 600 m, 13.7.1991, O.Benlioğlu, BULU 6255. - IZMİR: Boz Mo., 1300 m, D. 18232 (Davis 1965).
- B 2: BALIKESİR: Bigadiç: Ulus Mo., around Dağarcık, 1000 m, 13.6.1987, O.Benlioğlu, BULU 6140 (Kaynak and Tuyji 1991). - BURSA: Mustafakemalpaşa: around Suuçtu, under *Fagus* and *Pinus* forest, streambed, rocks, 680-700 m, 14.5.1990, O.Benlioğlu, BULU 4333. - Tahtaköprü to Domaniç, 12 km, under *Fagus* and *Carpinus* forest, streambed, rocks, 1200 m, 6.7.1991, BULU 6204. - IZMİR: Ödemiş: Bozdağ, in *Castanea* forest, 7.7.1962, C.Regel (Demiriz et all. 1969).
- \*\* B 3: AFYON: Ayazın village, Köyalı location, rocks, 1250 m, 18.6.1995, O.Benlioğlu, BULU 9515.
- C 2: MUĞLA: Fethiye: Seki Yaylası, 6.1946, A.Heilborn et M.Basarman (Demiriz et all. 1969).
- C 6: HATAY: Amonos, Haradj. 167 (Davis 1965).
- A. distentifolium* Tausch ex Opiz



- \*\* A 3:** IZMIT: Keltepe, under the *Fagus* forest, streamside, 1420 m, 21.6.1990, O.Benlioğlu, BULU 4439.
- A 7: GİRESUN: Balaban Mo., 2700 m, D. 20617 (Davis 1965). - TRABZON: between Çaykara and Bayburt: Soğanlı Mo., 2600 m, 28.7.1995, O.Benlioğlu, BULU 9518.
- A 8: RİZE: Çaykara: Uzungöl road, under *Alnus* forest, 230 m, 27.8.1993, G.Kaynak et G.Tarımcılar, BULU 7816. - Çamlıhemsin, roadside, rocky slopes, 520 m, 28.8.1993, G.Kaynak et G.Tarımcılar, BULU 7878 (Kaynak et O.Tuyji 1994). - GÜMÜSHANE: Haldizan, 2500 m, Balls 1878. - Çoruh: nr. Artvin (Grossheim 1: map 25).
- A 9: Çoruh: 20 km, E Savsat, 2100 m., 81-75-44 (Sorger et Buchner 1983).

## ASPIDACEAE

### *Polystichum woronowii* Fomin

- \*\* A 3:** ZONGULDAK: near Düzpelit, in maquis, 270 m, 30.9.1995, G.Tarımcılar, BULU 9406.
- A 7: GİRESUN: Ülper village, waterside, 1200 m, 21.5.1983, E.Aktoklu et S.Yıldırım (Yıldırım and Güner 1989).

### *Dryopteris caucasica* (A. Br.) Fraser-Jenkins et Corley

- A 1 (E): Kırklareli: nr top of Mahya Mo., 1975, Jenkins (Davis 1988).
- A 2: BURSA: Uludağ: Soğukpınar, under *Fagus* forest, damp and shady place in streambed, 1400 m, 8.7.1992, O.Benlioğlu, BULU 6408. - Sarıalan: under *Fagus* and *Abies* forest, damp and shady places, 1500 m, 19.8.1992, O.Benlioğlu, BULU 6418.
- A 3: BOLU: Bolu to Abant Gölü, 3 km, under *Abies* forest, 1400 m, 24.7.1995, O.Benlioğlu, BULU 9519. - 25 km, to Yedigöller National Park, 230, 28.8.1994, G.Kaynak et G.Tarımcılar, BULU 9164.
- A 4: BOLU: 5 km W of Yeniçağa, Jenkins 2409 (Davis 1988) - KASTAMONU: between Ağlı and Cide: around Valay, 640 m, under *Fagus* and *Abies* forest, 29.8.1994, G.Kaynak et G.Tarımcılar, BULU 9094.
- \*\* A 5:** KASTAMONU: between Tosya and Tasköprü, mixed forest, 1100 m., 21.8.1994, G.Kaynak and G.Tarımcılar, BULU 9094.
- A 7: TRABZON: 2 km below Küçükkonak, Zigana pass, Jenkins 2270-2275 (Davis 1988).
- A 9: ARTVIN: Çoruh: Yalnızçam Mo., 1800 m, Jenkins (Davis 1988).

### *D. filix-mas* (L.) Schott

- A 1 (E): Kırklareli: Mahya Mo., 800 m., 12.6.1968, A.Baytop et B.Çubukçu İSTE 13279 (Demiriz et all. 1969).
- A 1 (A): BALIKESİR: Erdek: Kapıdağ, under *Fagus* forest, 580 m, 18.7.1991, O.Benlioğlu, BULU 6266.
- A 2 (E): İSTANBUL: Valide Bend, VII 1891, Azn (Davis 1965).
- A 2 (A): İSTANBUL: Ağva to Sile, 14.5 km, under coppice-Wood, edge of water, 31.3.1968, H.Demiriz, İSTF 26154. - (Demiriz et all. 1969). - BURSA: Uludağ: below Kusaklıkaya, amongst granite rocks, 1900 m, 31.8.1989, O.Benlioğlu, BULU 6440. - between Keles and İnegöl, under *Fagus* forest, rocky slopes, 1500 m, 18.6.1987, G.Kaynak, BULU 2283 (Kaynak and Tuyji 1991). - YALOVA: Termal, streamside, in forest, 110 m, 24.6.1992, O.Benlioğlu, BULU 6382. - IZMIT: Ulaşlı: Uzundere, under *Fagus* and *Castanea* forest, valley, rocks, 580 m, 26.6.1991, O.Benlioğlu, BULU 6332. - Keltepe: wet rocky place in forest, 760 m, 21.6.1990, O.Benlioğlu, BULU 4442.
- A 3: ZONGULDAK: E fringe of town: E and ESE side of Fenerburnu hill, *Lauretum*, 70 m, 13.5.1956 H.Demiriz 2570. - Devrek road, 6-7 km, edge of forest, 260 m, 14.5.1956, H.Demiriz 2665 (Demiriz et all. 1969). - BOLU: Karadere, Kühne 893 (Davis 1965). - Yedigöller National Park, under mixed forest, 310 m, 28.8.1994, G.Kaynak et G.Tarımcılar, BULU 9176.
- A 4: ZONGULDAK: Amasra: along stream S of Amasra, streamside, 10 m, 21.2.1967, M.Durak, İSTF 25059 (Demiriz et all. 1969). - KASTAMONU: Araç to Daday, 12 km, under mixed forest (*Pinus*, *Quercus*, *Ulmus*), 1040 m, 21.8.1994, G.Kaynak et G.Tarımcılar, BULU 8907. - between Kastamonu and Tosya, edge of forest, 1100 m, 21.8.1994, G.Kaynak et G.Tarımcılar, BULU 8942. - between Ağlı and Senpazar: 1 km to Sada village, under *Abies* forest, 920 m, 27.8.1994, G.Kaynak et G.Tarımcılar, BULU 9079. - between Senpazar and Cide, in mixed forest, 890 m, 27.8.1994, G.Kaynak et G.Tarımcılar, BULU 9118. - between Cide and Kurucasile, underwood, 1050 m, 27.8.1994, G.Kaynak et G.Tarımcılar, BULU 9134. - ANKARA: Kızılcahamam, underwood, 2.6.1947, H.Bağda 1134 (Demiriz et all. 1969).
- A 5: SAMSUN: Alaçam to Kızılan, 20 km, edge of forest, 650 m, 25.8.1994, G.Kaynak et G.Tarımcılar, BULU 9007. - SİNOP: Ayancık: Gürgendibi, under mixed forest, 70 m, 25.8.1994, G.Kaynak et G.Tarımcılar, BULU 9015. - Çangal Mo., above Ayancık, forest, 1090 m, 26.8.1994, G.Kaynak et

G.Tarımcılar, BULU 9047. - KASTAMONU: Tosya: around Ahlatdağı, *P. nigra* forest, 1500 m, 11.6.1975, Kılınç 3067 - ÇORUM: Kargı: Kösedag locality, *P. sylvestris* forest, streamside, 1650 m, 15.7.1976, Kılınç 5031 (Kılınç 1985).

- A 6: ORDU: Bakadjak, Hand-Mazz. (Davis 1965). - Ünye to Karakus, 1000 m, D. 24909 (Davis 1965). - Sivas: Yıldız Mo., between Yusufoglu and Yakupoğlu 1989, C 4253, (Civelek 1992).
- A7: GİRESUN: Gönüllü village, under *Corylus* plantation, 170 m, 26.8.1993, G.Kaynak et G.Tarımcılar, BULU 7789. - Görele: 7 km W of Görele, roadside, rocks, 60 m, 26.8.1993, G.Kaynak et G.Tarımcılar, BULU 7797 (Kaynak and Tuyji 1994). - TRABZON: 3 km S of Hamsiköy, mixed forest of *Picea* and *Fagus* with shrublayer of mainly *Carpinus*, *Corylus*, *Alnus*, *Sambucus*, *Ribes* and *Rhododendron*, 1900 m, 5.6.1959, İter Leydenense 1841 (Demiriz et all. 1969).
- A 8: RİZE: crossroad to İkizdere, streamside, rocks, 27.8.1993, G.Kaynak et G.Tarımcılar, BULU 7823. - Çamlıhemsin, roadside, shady rocky places, 440 m, 28.8.1993, BULU 7868. - ARTVIN: Borçka, damp rocks, 670 m, 29.8.1993, G.Kaynak et G.Tarımcılar, BULU 7909.
- A 9: ARTVIN: Kutul, 13.7.1947, A.Heilborn et M.Basarman.(Davis 1965) - Arpaçay: Karakule village, rocky places of Raktar vicinity, 2300 m, 16.6.1984, O. 2135 (Ocakverdi and Ekim 1986).
- B 1: BALIKESİR: Burhaniye: SW slopes of Madra Mo., valley, amongst granite rocks, 1060 m, 10.7.1991, O.Benlioğlu, BULU 6235. - MANİSA: Sipil Mo., along Karaçay, 150-450 m, 23.4.1984, Yıldırım 6015 (Yıldırım 1989).
- B 2: BALIKESİR: Dursunbey: Alaçam Mo., Cendere pass, rocky places in forest, 900-1000 m, 6.6.1987, O.Benlioğlu, BULU 6129. - Bigadiç: Ulus Mo., around Dağarcık, 1000 m, 13.6.1987, O.Benlioğlu, BULU 6142. - İnegöl: around Oylat thermal spring, mixed forest of *Fagus* and *Quercus*, rocks, 700 m, 29.6.1988, G.Kaynak et O.Benlioğlu, BULU 3145. - Keles: below Gelemiş village, rocks in valley, 595 m, 4.7.1989, G.Kaynak, BULU 4196 (Kaynak and Tuyji 1991). - Tahtaköprü to Domanıç, 13 km, under *Fagus* and *Carpinus* forest, streambed, rocks, 1210 m, 6.7.1991, BULU 6207. - KÜTAHYA: Murat Mo., below Karlık, 1700 m, 27.10.1977, A.Çirpıcı, Ç. 31202 (Çirpıcı 1989). - İZMİR: Bozdağ, 6.1946, A.Heilborn et M.Basarman (Demiriz et all. 1969).
- \*\* B 3: AFYON: Sincanlı: Değirmendere location, streamside, 1300 m, 9.6.1995, O.Benlioğlu, BULU 9516.
- B 4: ANKARA: Dikmen tepe, Gipfel, Nordseite. zwischen Felsen, ca. 1200 m, 25.6.1932, W.Kotte (Demiriz et all. 1969).
- B 5: NIĞDE: Hasan Mo., above Taspınar, 1900 m, D. 19014 (Davis 1965).
- C 3: KONYA: Beyşehir Gölü, around Yesildağ, reedy, 1121 m, 16.7.1985, M.Küçüködük, K 374 (Küçüködük 1989).
- C 4: ANTALYA: Taseli Platosu: Gazipasa, Çobanlar köyü Yaylası, 1900 m, 19.7.1981, Sümbül 1110. - KONYA: Kılbasan: Karadağ, 1200-1600 m (Ocakverdi and Ünal 1991).
- C 6: HATAY: Amonos Mo., Haradj. 420 (Davis 1965).

***D. affinis* (Lowe) Fraser-Jenkins subsp. *borreri* (Newman) Fraser-Jenkins**

A 2 (E): İSTANBUL: Valide Bend. vii 1891, Azn. (Davis 1965).

A 2 (A): İSTANBUL: around spring of Tasdelen suyu, underwood, edge of water, 16.10.1966, H.Demiriz 6131.

A 3: ADAPAZARI: Düzce to Akçakoca, Walter 4604 (Demiriz et all. 1969). - Akyazı: Pazarköy to Güzlek, 3 km, *Fagus* forest with shrublayer of mainly *Corylus*, *Rhododendron* 140 m, 10.5.1991, O.Benlioğlu, BULU 6188. - BOLU: 25 km from Yedigöller National Park, in mixed forest, 230 m, 28.8.1994, G.Kaynak et G.Tarımcılar, BULU 9161.

A 4: KASTAMONU: between Kastamonu and Tosya, forest, 950 m, 21.8.1994, G.Kaynak et G.Tarımcılar, BULU 8927.

\*\* A 5: KASTAMONU: between Tosya and Tasköprü, mixed forest, 1100 m, 21.8.1994, G.Kaynak et G.Tarımcılar, BULU 8949.

A 6: ORDU: Ünye to Kakus, 1000, D. 24908 (Davis 1965).

A 7: GİRESUN: Bulancak to Giresun, 5 km, under *Fagus*—*Castanea* forest, waterside, 10 m, 25.7.1995, O.Benlioğlu, BULU 4334. - Maçka to Meryemana, 16 km, mixed forest of *Pinus*, *Alnus*, *Carpinus*, 13.7.1966, H.Demiriz 5700 B (Demiriz et all. 1969).

A 8: ARTVIN: Arhavi: Dikyamaç village: Akıncılar quarter, under trees and *Corylus* plantation, 26.8.1967 - Hopa: Sarp: Turkish-Russian frontier, roadside, edge of forest, 0 m, 11.7.1966, H.Demiriz 5685 (Demiriz et all. 1969).

***D. pallida* (Bory) Fomin subsp. *pallida***



- A 2: BURSA: Yenisehir, around Seymen village, rocks, 450 m, 21.5.1987, G.Kaynak, BULU 1978. - Ericek to Fezviye, 3 km, rocks, 650 m, 27.7.1991, O.Benlioğlu, BULU 6273. - Uludağ: around Inkaya village, *Quercus* bushes, rocks, 450 m, 30.7.1991, O.Benlioğlu, BULU 6292. - Gemlik: above Karsak village, rocks in valley, 370 m, 27.7.1991, O.Benlioğlu, BULU 6289. - YALOVA: in vicinities of Güneyköy, streamside, rocks, 400 m, 16.7.1987, G.Kaynak et O.Benlioğlu, BULU 2685 (Kaynak and Tuyji 1991).
- B 1: BALIKESİR: Konakpınar: Kozderegüvem, near Güvem rivulet, 400 m, 12.7.1986, O.Benlioğlu, BULU 6120. - Balıkesir to İzmir, 35 km, Aritaskaya pass, under rocks, 450 m, 15.5.1987, O.Benlioğlu, BULU 6126 (Kaynak and Tuyji 1991). - between Balıkesir and Edremit: crossroad to Balya, maquis and rocks, 150 m, 10.7.1991, O.Benlioğlu, BULU 6223. - Burhaniye: Madra Mo., Kılık hill, under *P. nigra* forest, 800 m, 10.7.1991, O.Benlioğlu, BULU 6227. - ÇANAKKALE: Evciler: Kazdağ: above Ayazma gorge, rocks, 470 m, 12.7.1991, O.Benlioğlu, BULU 6246. - MANISA: Kırkağaç: Sarıkaya hill, maquis, 8.9.1965, H.Pesmen 1203. - İZMİR: Bergama: Kozak: Asağbey, 24.4.1950, R.Okay. - Dikili: between Gürün and Geyik Mo., *P. nigra* forest, 24.6.1965, H.Pesmen 1195. - Yamanlar Mo., *P. nigra* forest, 6.8.1965, H.Pesmen 1198. - Nif Mo., *P. brutia* forest, 29.5.1966, H.Pesmen 1206. - Gümüldür, in *Pinus* forest, 5.5.1962, C.Regel (Demiriz et al. 1969).
- B 2: BALIKESİR: Dursunbey: Alaçam Mo., Candere pass, N slopes of Gavurtepe, rocks, 850-1000 m, 6.6.1987, O.Benlioğlu, BULU 6128. - Sındırgı: Emendere thermal spring, under maquis, 750 m, 5.7.1987, O.Benlioğlu, BULU 6155. - BURSA: Keles: below Gelemiş village, rocky places in valley, 595 m, 4.7.1989, G.Kaynak, BULU 4193. (Kaynak and Tuyji 1991) - Inegöl: between Inegöl and Oylat: around Hilmiye village, rocky place, 600 m, 6.7.1991, O.Benlioğlu, BULU 6198. - Harmancık: Harmancık to Orhaneli, 15 km: Çataltepe, under *P. nigra* and *Quercus* forest, rocks, 1000 m, 6.7.1991, O.Benlioğlu, BULU 6411. - Inegöl: Mezit 7, steep rocks, 690 m, 13.6.1991, O.Benlioğlu, BULU 6420. - KÜTAHYA: Murat Mo., above Çukurören, Kapsıca location, 1400 m, 13.8.1977, A.Çırpıcı, Ç. 31025 (Çırpıcı 1989).
- \*\* B 3: İSPARTA: Uluborlu: NE facing slopes of Tekke hill, rocky, 1750 m, 21.7.1995, G.Kaynak, BULU 9487. - AFYON: Bayat: in the vicinities of Olukpınar village, rocks, 1200 m, 12.7.1995, O.Benlioğlu, BULU 9517.**
- B 4: ANKARA: Elmadag, 14.7.1939, B.Kasaplıgil (Demiriz et al. 1969).
- B 5: NİĞDE: behind Asmasız köyü, rocks, 2050 m, 30.6.1982, Eyce 87 (Eyce and Ocakverdi 1987).
- B 6: MARAS: Kuru Mo., nr. Zeytun, Balls 1024 (Davis 1965).
- B 8: BITLİS: Çukur: Asağı Kolbası, valley, rocks, 1340 m, 20.5.1978, G.Kaynak (Kaynak 1989).
- B 9: AĞRI: Berktepe: N side of Salihbey, 2010 m, 23.6.1989, 6067 (Gümüş 1992). - BITLİS: Süphan Mo., 3000 m, D. 24735 (Davis 1965).
- C 1: AYDIN: Kusadası: Kalamaki rivulet, *P. brutia* and maquis, 30.7.1965, H.Pesmen 1201. - Samsun Mo., in Pineto, 6.1965, C.Regel. (Davis 1965).
- C 2: AYDIN: Kusadası: Kalamaki rivulet, *P. brutia* forest, 28.19.1965, H.Pesmen 1202. - MUĞLA: Marmaris: between Turgut and Bayır, 50 m, 15.4.1965, P.Davis, 41132. - Fethiye: road to Seki, 5.1946, A.Heilborn et M.Basarman (Demiriz et al. 1969). - Denizli: Tasocağı, nr. Denizli, D. 13265 (Davis 1965).
- C 3: ANTALYA: Kumluca: Beydağ, under *P. brutia* forest, Exp. SW, 1600 m, 22.8.1966, F., Seker et E.Turan. - Kemer: Kesme çayı series. - Tahtalı, NW, 475 m, 8.7.1966, K.Iyicil et M.Somer, ISTO 5835. - Antalya to Bucak, 34 km, dry river-bed, rocks, 28.9.1968, H.Demiriz, ISTF 26680. - Çubuk pass, above pass, rocks, 875-900 m, 28.9.1968, H.Demiriz, ISTF 26682. - Selimiye: 5 km S of Manavgat: in ruins of Side, on limy soil, in shrubs, 10 m, 23.4.1959, İter Leydenense 642. (Demiriz et al. 1969).
- C 4: ANTALYA: between Alanya and Deretürbenaz: Bektas fountain, 385 m, 24.2.1966, A.et T.Baytop, İSTE 8528. - İÇEL: Anamur to Gazipasa, 35 km, *Pinetum*, rocks, 450 m, 27.9.1968, H.Demiriz, ISTF 26673 (Demiriz et al. 1969).
- C 5: İÇEL: Mersin: Fındıkpınarı to Kuzucubelen, 2 km, rocky and stony slopes, 22.3.1967, H.Demiriz, ISTF 25142. - W fringe of Turunçlu: above Pınarbaşı location, rocky high maquis, under rock, 300 m, 30.9.1951, H.Demiriz 809. - ADANA: Toros: Bürücek, 7.7.1937, without collector. - HATAY: Arsuz: near Gök Mustafa: Amonos Mo., under growth in *P. nigra* forest, 1100 m, 8.6.1967, Y.Akman (Demiriz et al. 1969).
- C 6: HATAY: Dörtöl: Rabat, base of limestone cliff, 100 m, 5.5.1965, M.J.E. Coode et B.M.G. Jones 490. - İSKENDERUN: Soğukoluk: Karlıktepe: Amonos Mo., under *A. cilicica* forest, 1300 m, 24.5.1966, Y.Akman 3357 (Demiriz et al. 1969). - Seyhan: Döldül Mo., between Gökçayır and Atlık. Y., 1400-1700 m, D. 16444. (Davis 1965).

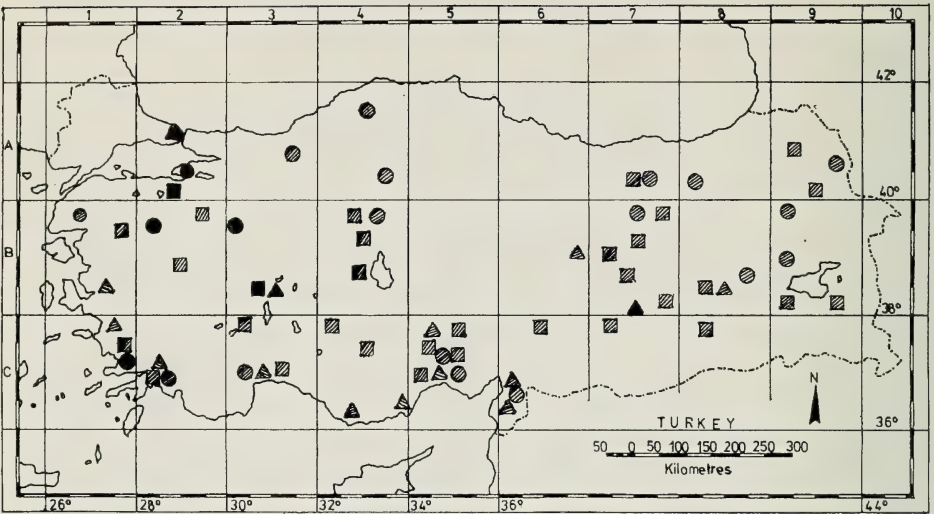


Figure 1:

- ▨ *Cheilanthes persica* (Bory) Kuhn (The distribution in Turkey)    ▲ *Cheilanthes pteridioides* (Reich.) C. Chr. (The distribution in Turkey)
- *C. persica* (Bory) Kuhn (New Records)    ▲ *C. pteridioides* (Reich.) C. Chr. (New Record)
- ◐ *Cheilanthes marantae* (L.) Domin subsp. *marantae* (The distribution in Turkey)
- *C. marantae* (L.) Domin subsp. *marantae* (New Records)

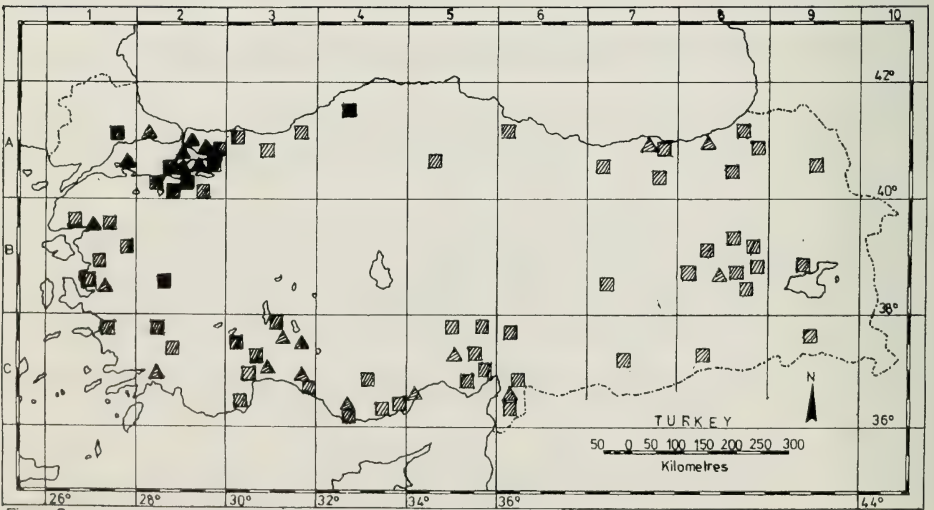


Figure 2:

- ▨ *Anogramma leptophylla* (L.) Link (The distribution in Turkey)
- ▲ *A. leptophylla* (L.) Link (New Record)
- ▨ *Adiantum capillus-veneris* L. (The distribution in Turkey)
- *A. capillus-veneris* L. (New Records)



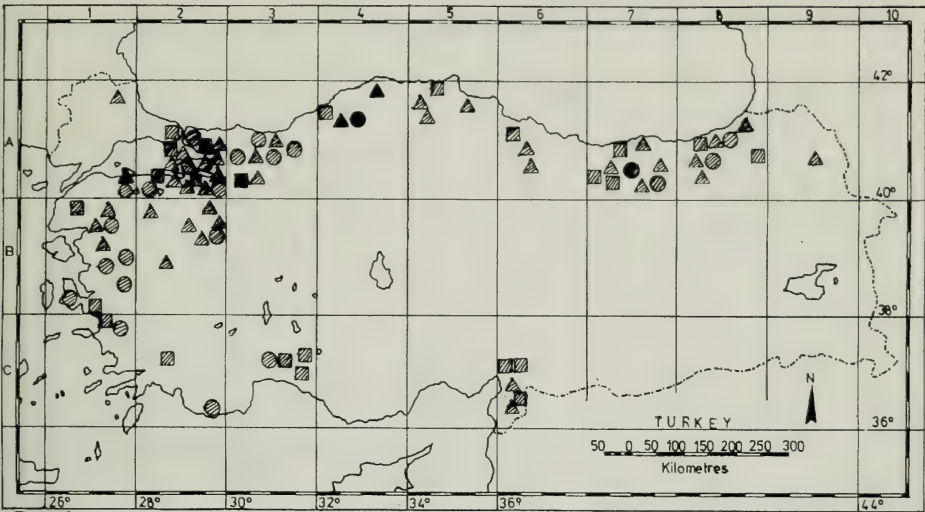


Figure 3:

- ▲ *Polypodium vulgare* L. (The distribution in Turkey)
- ▲ *P. vulgare* L. (New Records)
- *Polypodium interjectum* Shivas (The distribution in Turkey)
- *P. interjectum* Shivas (New Record)
- *Polypodium australe* Fe'e (The distribution in Turkey)
- *P. australe* Fe'e (New Record)

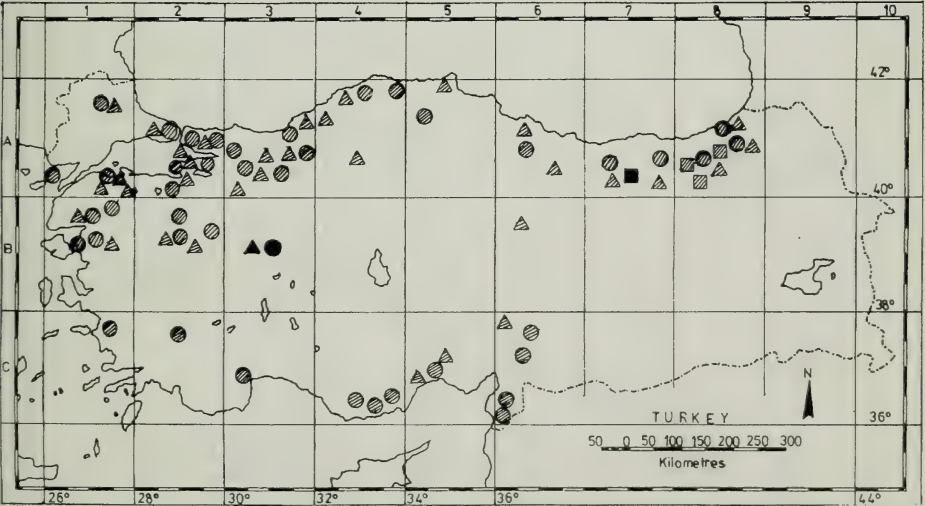


Figure 4:

- ▲ *Asplenium adiantum-nigrum* L. (The distribution in Turkey)
- ▲ *A. adiantum-nigrum* L. (New Record)
- *Asplenium onopteris* L. (The distribution in Turkey)
- *A. onopteris* L. (New Record)
- *Asplenium septentrionale* (L.) Hoffm. subsp. *caucasicum* Fraser-Jenkins et Lovis (The distribution in Turkey)
- *A. septentrionale* (L.) Hoffm. subsp. *caucasicum* Fraser-Jenkins et Lovis (New Records)

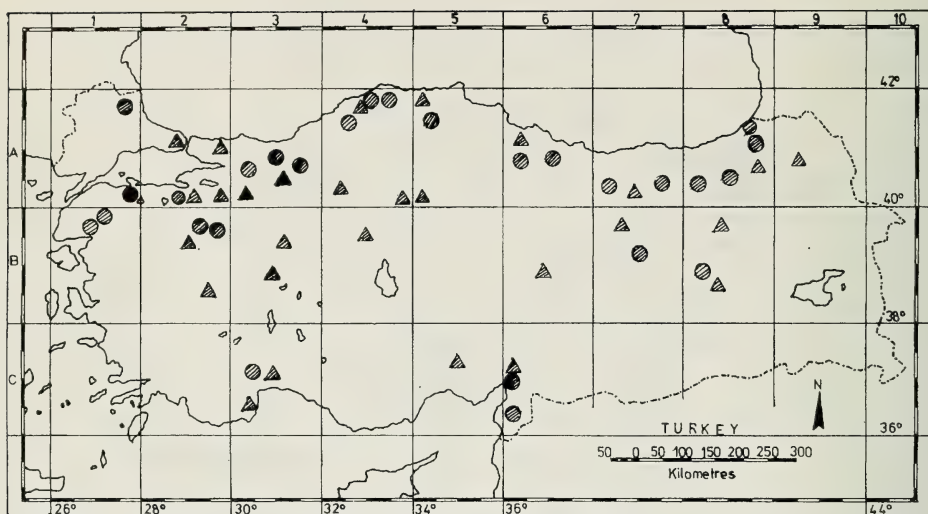


Figure 5:

- △ *Asplenium ruta-muraria* L. subsp. *ruta-muraria* (The distribution in Turkey)
- ▲ *A. ruta-muraria* L. subsp. *ruta-muraria* (New Records)
- *Asplenium scolopendrium* L. subsp. *scolopendrium* (The distribution in Turkey)
- *A. scolopendrium* L. subsp. *scolopendrium* (New Record)

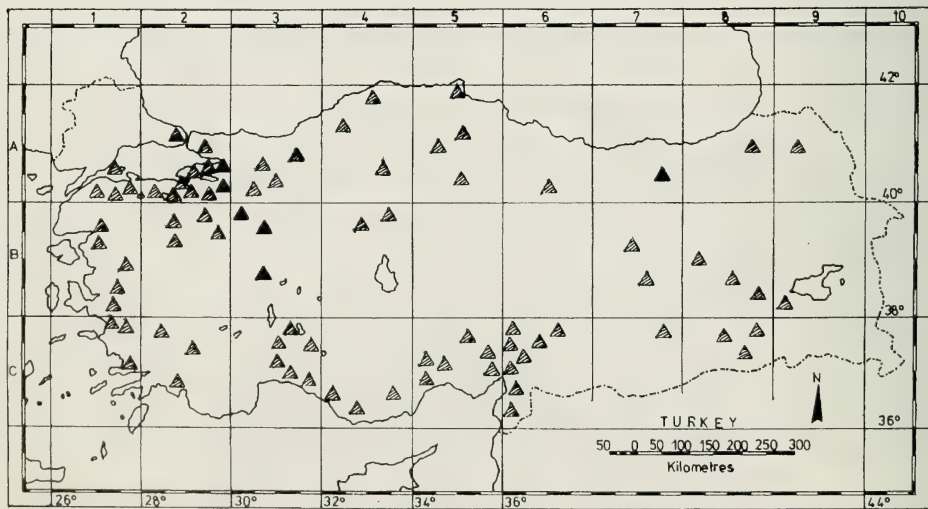


Figure 6:

- △ *Asplenium ceterach* L. subsp. *ceterach* (The distribution in Turkey)
- ▲ *A. ceterach* L. subsp. *ceterach* (New Records)



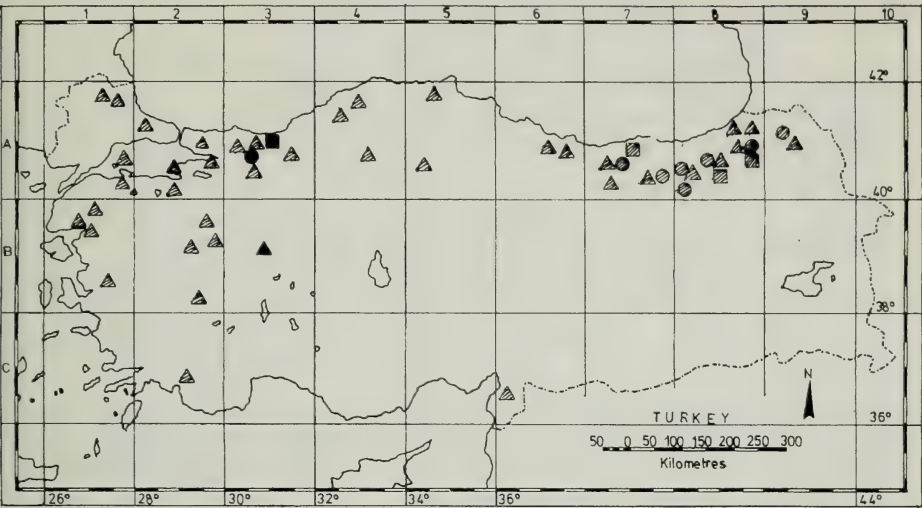


Figure 7:

- ▲ *Athyrium filix-foemina* (L.) Roth (The distribution in Turkey)
- ▲ *A. filix-foemina* (L.) Roth (New Record)
- *Athyrium distentifolium* Tausch ex Opiz (The distribution in Turkey)
- *A. distentifolium* Tausch ex Opiz (New Record)
- *Polystichum woronowii* Fomin (The distribution in Turkey)
- *P. woronowii* Fomin (New Record)

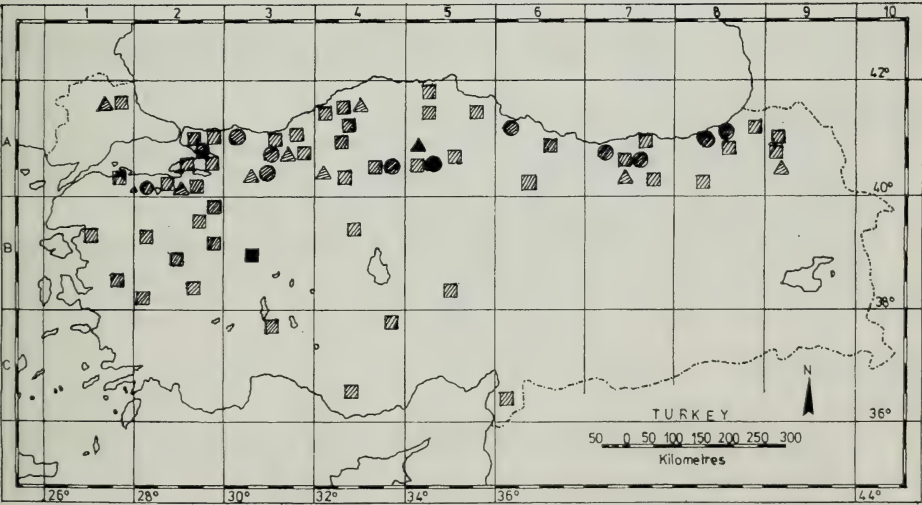


Figure 8:

- ▲ *Dryopteris caucasica* (A. Br.) Fraser-Jenkins et Corley (The distribution in Turkey)
- ▲ *D. caucasica* (A. Br.) Fraser-Jenkins et Corley (New Record)
- ▲ *Dryopteris filix-mas* (L.) Schott (The distribution in Turkey)
- ▲ *D. filix-mas* (L.) Schott (New Record)
- *Dryopteris affinis* (Lowe) Fraser-Jenkins subsp. *borrieri* (Newman) Fraser-Jenkins (The distribution in Turkey)
- *D. affinis* (Lowe) Fraser-Jenkins subsp. *borrieri* (Newman) Fraser-Jenkins (New Record)

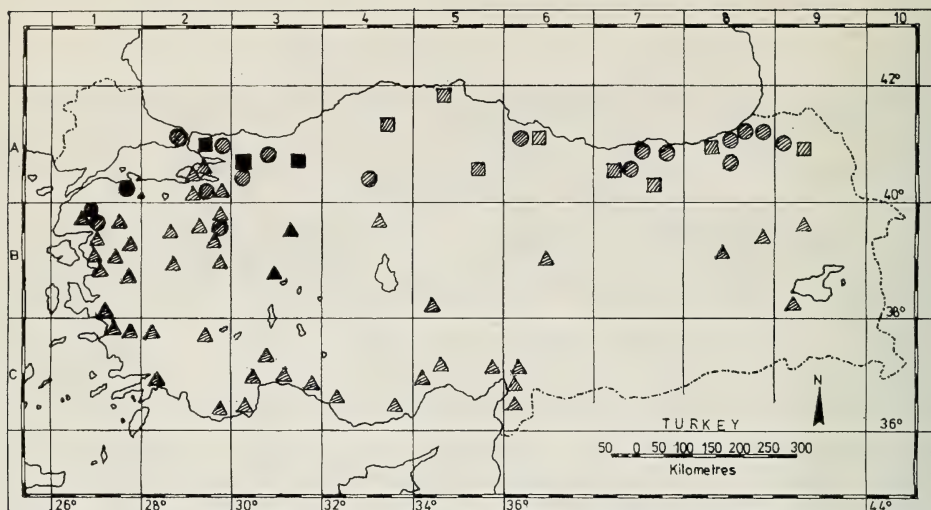


Figure 9:

- ▲ *Dryopteris pallida* (Bory) Fomin subsp. *pallida* (The distribution in Turkey)  
 ▲ *D. pallida* (Bory) Fomin subsp. *pallida* (New Records)  
 ▨ *Dryopteris dilatata* (Hoffm.) A. Gray (The distribution in Turkey)  
 ■ *D. dilatata* (Hoffm.) A. Gray (New Records)

- *Blechnum spicant* (L.) Roth (The distribution in Turkey)  
 ● *B. spicant* (L.) Roth (New Record)

### *D. dilatata* (Hoffm.) A. Gray

A 2 (A): ISTANBUL: Alem çayırı 3 vi 1895 Azn. (Davis 1965).

\*\* A 3: IZMIT: around Kel hill, roadside, under growth in *Fagus* forest, 1420 m, 21.6.1990, O.Benlioğlu, BULU 4437. - BOLU: 25 km from Yedigöller National Park, in mixed forest, 230 m., 28.8.1994, G.Kaynak et G.Tarımcılar, BULU 9164.

A 4: ZONGULDAK: NE von Yenice, Çitdere, 1030 m, Öz. (Sorgor 1985).

A 5: KASTAMONU: between Tosya and Çiftlik, underwood, 1120 m, 21.8.1994, G.Kaynak et G.Tarımcılar, BULU 8960. - SINOP: Ayancık: between Çangal and Kertil. in *Fagus-Abies* copse, 1400 m, Exp. S, 10.8.1945, B.Kasaplıgil (Demiriz et all. 1969).

A 6: ORDU: Bakadjak, Hand-Mazz. (Davis 1965).

A 7: TRABZON: Maçka: Meryemana, mixed forest of *Fagus*, *Carpinus*, *Alnus*, *Picea*, 1700 m, 26.7.1995, O.Benlioğlu, BULU 9520. - 3 km S of Hamsiköy, mixed forest of *Picea* and *Fagus*, with shrublayer of mainly *Carpinus*, *Corylus*, *Alnus*, *Sambucus*, *Ribes* and *Rhododendron*, humid loamy soil, 1900 m, 5.6.1959, İter Leydenense 1845 (Demiriz et all. 1969).

A 8: ARTVIN: Arhavi: before Dikyamaç village, in mixed forest (*Fagus*, *Carpinus*, *Alnus*, *Ribes*, *Rhododendron*), 200 m, 27.7.1995, O.Benlioğlu, BULU 9521. - ARTVIN: Çoruh: nr. Artvin (Davis 1965).

A 9: KARS: nr. Kars, (Grossheim 1: map 15) (Davis 1965).

## BLECHNACEAE

### *Blechnum spicant* (L.) Roth

\*\* A 1 (A): BALIKESİR: Erdek: Kapıdağ, under the *Fagus* forest, 560 m, 18.7.1991, O.Benlioğlu, BULU 6263.

A 2 (E): ISTANBUL: Sarıyer: Belgrad forest: Valide bendi, very rare under pure stand, 22.1.1959, F.Yalınık, ISTO 786 (Demiriz et all. 1969).

A 2 (A): ISTANBUL: nr. source of Elmalı, 24 v. 1891, Azn. (Davis 1965). - BURSA: Uludağ: below Cennetkaya, in forest, edge of water, amongst *Fagus orientalis* and *Vaccinium myrtillus* community, 1700 m, 30.7.1991, O.Benlioğlu, BULU 6303. - Sarıalan, under *Abies* forest, 1600 m, 19.8.1992, O.Benlioğlu, BULU 6303 A.

A 3: IZMIT: Keltepe, under *Fagus* forest, 1420 m, 21.6.1990, O.Benlioğlu, BULU 4445. - BOLU: Düzce: between Zonguldak and Devrek, roadside and edge of forest, 140 m, 30.9.1995, G.Tarımcılar, BULU 9409.

A 4: ANKARA: Hacıkadın, 7.1945, M.Basarman (Davis 1965).



- A 6: ORDU: Fatsa, rocks at Kayalar De., 30. Tobey 52 (Davis 1965).
- A 7: GİRESUN: Gönüllü village, under *Corylus* plantation, 170 m, 26.8.1993, G.Kaynak et G.Tarımcılar, BULU 7790 (Kaynak and Tuyji 1994). - between Kesap and Espiye, mixed forest of *Fagus*, *Carpinus* and *Castanea*, 30 m, 25.7.1995, O.Benlioğlu, BULU 9522. - TRABZON: Trabzon, 8.1935, Muzaffer (Davis 1965).
- A 8: RİZE: Çamlıhemsin, on damp rocks, 120 m, 28.8.1993, G.Kaynak et G.Tarımcılar, BULU 7854. - RİZE: Rize: around Söğütü village, 0 m, 28.8.1993, G.Kaynak et G.Tarımcılar, BULU 7848 (Kaynak and Tuyji 1994). - ARTVIN: Arhavi: before Dikyamaç village, in mixed forest (*Fagus*, *Carpinus*, *Alnus*, *Rhododendron*, *Ribes*), 450 m, 27.7.1995, O.Benlioğlu, BULU 9523. -ARTVIN: between Artvin and Borçka, roadside, damp rocks, 160 m, 29.8.1993, G.Kaynak et G.Tarımcılar, BULU 7879 (Kaynak and Tuyji 1994).
- A 9: ARTVIN: Çoruh: nr. Ardanuç (Grossheim 1: map 34) (Davis 1965).
- B 1: BALIKESİR: Kaz Mo., by Edremit, Walter 534 (Davis 1965). - ÇANAKKALE: Bayramiç: Evciler region: around Uzunoluk, 18.8.1951, I.Akbas, ISTO 302 (Demiriz et all. 1969).
- B 2: BURSA: between Tahtaköprü and Domaniç: Kocayayla, under *Fagus* and *Carpinus* forest, streambed, 1370 m, 6.7.1991, O.Benlioğlu, BULU 6212.

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## CYTOLOGY OF SOME FERNS FROM THE NILGIRIS, SOUTH INDIA III

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### ABSTRACT

Chromosomal analysis of ten species of ferns from the Nilgiris, south India has been made for the first time. Three species, namely *Pseudocyclorus ochthodes* (Kunze) Holtum ( $n = 35$ ,  $2x$ ), *Dryopsis scabrosa* (Kunze) Holtum & Edwards ( $n = 41$ ,  $2x$ ) and *Trichomanes schmidianum* Zenker ex Taschn. ( $n = 72$ ,  $2n = 144$ ,  $16x$ ), have been studied from their type localities in the Nilgiris. The last one is a new cytotype.

### INTRODUCTION

The present paper giving cytological results for 10 species of ferns from the Nilgiris, south India, is a continuation of our work started in 1992. Two earlier papers (Irudayaraj, Bir & Manickam 1993, Irudayaraj & Bir 1994<sup>\*</sup>) give information on topography, vegetation and the cytology of 22 fern species.

### MATERIALS AND METHODS

Young fertile pinnae from wild plants were fixed in 1:3:6 mixture of chloroform, glacial acetic acid and 100% ethyl alcohol for 24 hrs and then preserved in rectified spirit (95% ethyl alcohol) for study in the laboratory. Acetocarmine squashes were made of young developing sporangia for the study of meiotic chromosomes ( $n$ =number) whereas somatic chromosomes were counted from mitosis in the tapetal cells of young sporangia. Vouchers are deposited in PUN (Herbarium, Punjabi University, Patiala) and XCH (Herbarium, St. Xavier's College, Palayamkottai).

### OBSERVATIONS

#### (a) Habitat and Distribution

These ferns, grow either terrestrially or lithophytically. *Pteris cretica* L. has simply pinnate laminae and slightly dimorphic pinnae (sterile pinnae with spinulose-serrate margins and fertile pinnae with entire margins). It is relatively rare in peninsular India growing along water courses in relatively open or sunny situations in the forests between 1,800-2,100 m. *Actiniopteris radiata* (SW.) Link with flabellate, semi-circular or wedge-shaped laminae having repeatedly dichotomously (up to 6 times) divided segments, is a low altitude lithophytic fern forming small colonies on roadside exposed dry rocks between 400-1,500 m. *Adiantum capillus-veneris* L. has bipinnate laminae and is rather rare, while *A. raddianum* C. Presl has tripinnate laminae and is very common. Both grow terrestrially or lithophytically in open or shaded places close to streams or even deep inside the forests between 1,200-1,600 m. *Pteridium aquilinum* (L.) Kuhn is a weed of comparatively high altitudes, 1,500-2,700 m, growing gregariously on exposed grassy slopes. Its deltoid-ovate, tripinnatifid, large-sized laminae are densely covered with soft whitish appressed hairs on their under surfaces. In dried conditions they are used as packing materials or as a litter in animal houses which, when mixed with dung, makes a very good manure. *Trichomanes schmidianum* Zenker ex Taschn. grows epiphytically or lithophytically in extremely moist conditions between 1,800-2,200 m but is rather rare. The lamina is about 6.0

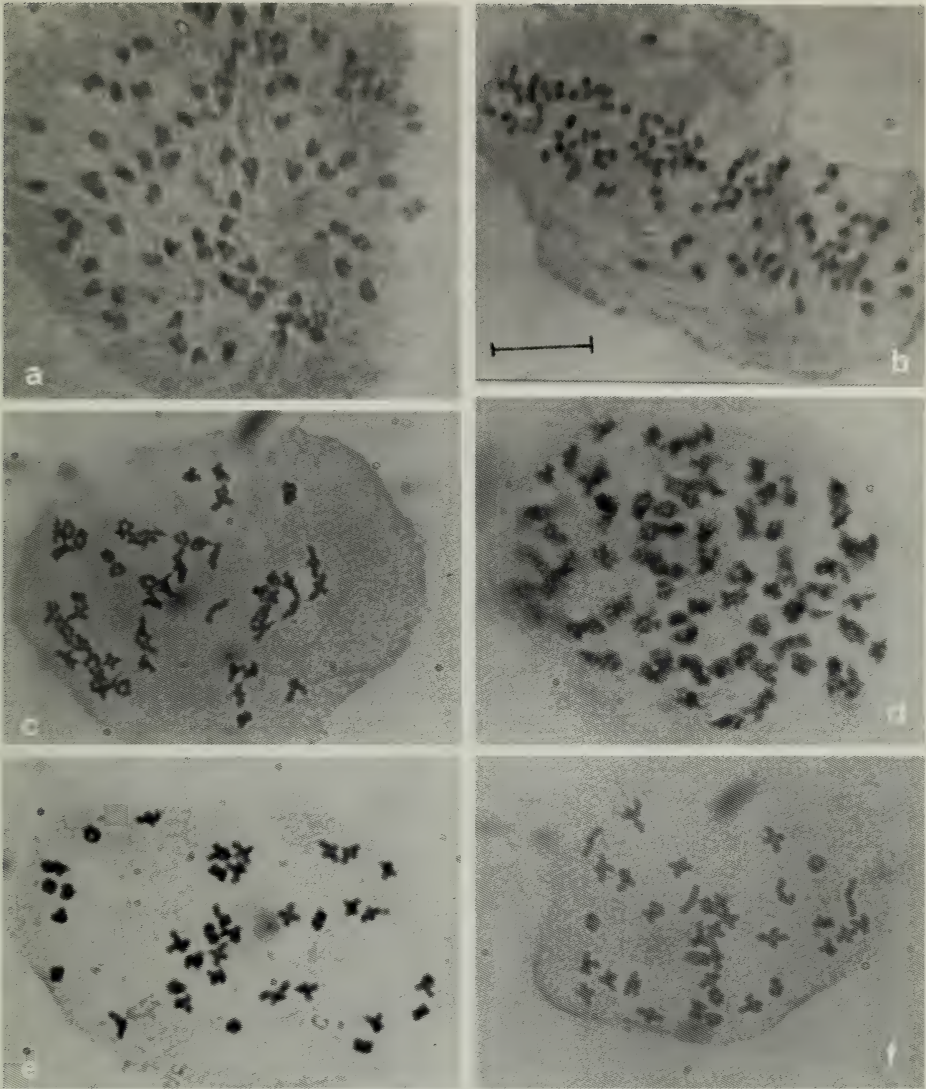
<sup>\*</sup> On page 306 under 7. *Athyrium lanceum* (Kunze) Moore, in first line *Athyrium lanceum* should correctly be read as *Athyrium macrocarpon* (Bl.) Bedd.



**Figure 1.** *Dryopsis scabrosa* (Kunze) Holttum & Edwards growing on the roadside forest margin near Dodabatta at 2500m. **Inset :** Frond of *Trichomanes schmidianum* Zenker ex Taschn. collected from extremely moist rocks near Ithalaru at 1900m.

× 2.5 cm. and bipinnatifid with broadly winged rachis and membranaceous texture. *Pseudocyclosorus ochthodes* (Kunze) Holttum, with type material coming from the Nilgiris, is rather common between 1,000-2,400 m and usually found as large colonies on fully or partially exposed roadsides or stream banks. Its large sized laminae are pinnate with pinnae up to 20 x 1.5 cm. It is highly variable species as to the pubescence, nature of rhizome, size of plant, etc. and south Indian plants have been distinguished into their two varieties *annamalayayensis* and *palniensis* by Manickam & Irudayaraj (1990). Nilgiris specimens also exhibit very great morphological variability, possibly due to habitat differences. *Tectaria coadunata* (J.Smith) C. Chr. has large bipinnate or bipinnatifid lamina densely covered with long hairs. It grows frequently along fully or partially shaded road side rocks between 1,200-1,800 m. *Dryopsis*





**Figure 2.** A-E. Meiosis in spore mother cells. A. *Actiniopteris radiata* (Sw.) Link.,  $n=2n'=87$ ; B. *Adiantum raddianum*, C. Presl,  $n=114$ ; C. *Pteridium aquilinum* (L.) Kuhn,  $n=52$ ; D. *Trichomanes schmidianum* Zenker ex Taschn., 72 II; E, F. *Pseudocyclosorus ochthodes* (Kunze) Holttum,  $n=35$ . Scale bar =  $10\mu\text{m}$  throughout.

*scabrosa* (Kunze) Holttum & Edwards, with large-sized tripinnate laminae, is endemic to south India and grows on partially shaded rocks, open forest floors or road-side forest edges between 2,100-2,500 m. This is a high altitude Nilgiris fern with short, soft dark brown appressed hairs distributed densely or sparsely all over the stipe, rachis, costules and veins. Finally, *Dryopteris cochleata* (Buch. Ham. ex D. Don) C. Chr. is a low level rare species frequently growing in the open along roadsides, on forest floors or on forest clearings between 400-500m. altitude but often extends to 1,500m altitude. It has dimorphic bipinnate fronds with its sterile fronds up to 40 x 20 cm and its fertile ones 30 x 12 cm.

TABLE 1  
Chromosome Numbers of some ferns\* from the Nilgiris, south India

Sp. No.	Name of the species	Locality & Altitude	Voucher Number	Chromosome Number	Ploidy and Reproduction
1.	<i>Pteris cretica</i> L.	Ithalaru, 1,900m	PUN 4295 4296	n=87 '2n'=87	Triploid apogamous
2.	<i>Actiniopteris radiata</i> (Sw.) Link (= <i>Actiniopteris dichotoma</i> Kuhn)	Coonoor 1,500m	XCH 3388	n=87 '2n'=87 (Fig. 2A)	Triploid apogamous
3.	<i>Adiantum capillus-veneris</i> L.	Coonoor 1,600m	XCH 3390	n=30	Diploid sexual
4.	<i>Adiantum raddianum</i> C.Presl (= <i>Adiantum cuneatum</i> Langsd. & Fisch)	Coonoor 1,600m	XCH 3389	n=114 (Fig. 2B)	Octaploid sexual
5.	<i>Pteridium aquilinum</i> (L.) Kuhn ex Decken	Ithalaru 1,900m	PUN 4293 4294	n=52 (Fig. 2C)	Diploid sexual
+6.	<i>Trichomanes schmidianum</i> Zenker ex Taschn. [ <i>Trichomanes pyxidiferum</i> (non L.) Ogata, <i>T. pyxidiferum</i> var. <i>limbatum</i> Wall ex Bedd. <i>Vandenboschia schmidiana</i> (Zenker) Copel.]	Ithalaru 1,900m	PUN 4305 - 4308	n=72 2n=114 (Fig. 2D)	16-ploid sexual
+7.	<i>Pseudocyclosorus ochthodes</i> (Kunze) Holttum [ <i>Lastrea grisea</i> Bedd., <i>L. ochthodes</i> Moore]	Ithalaru, 1,900m	PUN 4301 4302	n=35 (Figs. 2E, F)	Diploid sexual
8.	<i>Tectaria coadunata</i> (J.Smith) C.Chr. [ <i>Tectaria macrodonta</i> (Fée) C. Chr.]	Naduvattom: Gudalur road 1,500m	XCH 3385	n=41	Diploid sexual
+9.	<i>Dryopsis scabrosa</i> (Kunze) Holttum & Edwards [= <i>Lastrea scabrosa</i> (Kunze) Moore, <i>Polypodium nigrescens</i> Bedd., <i>Ctenitis scabrosa</i> (Kunze) Ching]	Dodabetta 2,500m Ithalaru 1,900m	PUN 4288 4289 4290 PUN 4291 4292	n=41   n=41	Diploid sexual   Diploid sexual
10.	<i>Dryopteris cochleata</i> (Buch. Ham. ex D. Don) C. Chr. [ <i>Lastrea filix-mas</i> var. <i>cochleata</i> (Buch. Ham. ex D. Don) Bedd.]	Naduvattom: Gudalur road, 1,500m	XCH 3384	n=41	Diploid sexual

\* First report from the Nilgiris.  
(See text for reports from other regions).

+ First analysis from the type locality.



### (b) Cytology

Three species namely, *Pseudocyclosotus ochthodes*, *Dryopsis scabrosa* and *Trichomanes schmidianum* are studied from their type localities in the Nilgiris. Information on location of materials, recorded chromosome numbers, ploidy level, reproduction mechanism and voucher specimens are given in Table 1. This shows that all except for two apogamous ferns, *Pteris cretica* ( $n=2n=87$ ) and *Actiniopteris radiata* ( $n=2n=87$ ), are sexual consequential to the normal course of meiosis resulting in production of 64 spores per sporangium.

## DISCUSSION

This is the first cytological report from the Nilgiris for all the ten species, although all of these have been studied previously from elsewhere in India. There are 6 diploid sexual, 2 triploid apogamous, one octoploid sexual and one 16-ploid sexual.

### 1. *Pteris cretica* L.

This is triploid apogamous fern ( $n=2n=87$ ) showing irregular meiosis in few 16-celled sporangia (with usually  $n$ -number of Is and IIs making  $2n=87$ ) and regular meiosis in 8-celled sporangia (with 87 autobivalents after failure of premeiotic mitosis). The result is 32 regular spores in 8-celled sporangia and variable number of irregular spores in the other type of sporangia.

From the Indian subcontinent this fern has been scored as both diploid apogamous ( $n=2n=58$ ) and triploid apogamous ( $n=2n=87$ ). The diploid apogamous cytotype is very well distributed throughout the Himalayas: recorded from Darjeeling (Mehra & Verma 1960), Sikkim (Verma 1961), Nainital (Verma & Loyal 1960, Verma & Khullar 1965), Mussoorie (Mehra & Verma 1960, Verma & Khullar 1965), Kulu: Manikaran (Khullar & Mehra 1972), Simla (Verma & Khullar 1965), Dharamsala (Verma & Khullar 1965) and Dalhousie (Verma & Khullar 1965) while the triploid apogamous cytotype is known from only the western Himalayas: Dalhousie-Khajjar road, Dalhousie-Chamba road, where it is locally common (Verma & Khullar 1965) and Mussoorie (Mehra & Verma 1960). Both  $2x$  and  $3x$  apogamous forms are known from the Parasnath Hills (Roy & Pandey 1962). Vasudeva & Bir (1982) recorded the diploid apogamous cytotype from Pachmarchi in central India. In contrast, the species is scored as  $3x$  apogamous from western Ghats by Irudayaraj and Manickam (1987) and Manickam & Irudayaraj (1988) and here from the Nilgiris. Only Himalayan voucher specimens of  $2x$  and  $3x$  apogamous cytotypes were available for study. No well-marked phenotypic difference could be made out between the two categories, thus confirming the earlier view of Verma & Khullar (1965). It is not practically possible to separate the two in the field or the herbarium without resorting to chromosome counts. However, according to Verma & Khullar (1965) both spore and stomatal dimensions are larger in the triploid apomicts. They also point out that triploids from Khajjar-Chamba road (Dalhousie) generally have a broad yellow streak in the centre of the pinnae while the margins are comparatively green. This type colour differentiation could not be made out in the Nilgiris specimens (PUN 4295, 4296), but possibly this distinction is only noticeable in fresh material. Verma & Khullar (1965) do point out that there is no resemblance what so ever to the triploid apogamous *Pteris cretica* var. *albolineata* Hook. which also possesses a white broad strip along the midvein throughout the entire length of the pinnae (Verma 1959).

### 2. *Actiniopteris radiata* (Sw.) Link

Nearly 90% of the sporangia of this triploid apogamous fern are 8-celled and show  $n=87$  (Figure 2 A) through regular meiosis. The other 10% are 16-celled with highly irregular meiosis with  $n$ -Is & IIs giving  $2n=87$  and finally highly irregular spores. Earlier, records show both  $2x$  and  $3x$  apogamous cytotypes from north India (Mehra & Verma 1960) but only the  $3x$

apogamous is known from south India (Kuriachan & Ninan 1976, Manickam & Irudayaraj 1988). There are no phenotypic differences in the 2x and 3x apogamous cytotypes except for only one report of the 2x apogamous from Meerut when Mehra & Verma (1960) reported the individual to be sickly looking. In the material of 3x apogamous collected from Meerut, north India, Mehra & Verma (1960) counted  $2n=87$  from archesporial mitosis confirming the meiotic counts. Stokey (1948) attributed the apogamous nature of the fern to xeric habitat, but this is a specific attribute and cannot be applied in general to all apomictic ferns, because many of these grow in mesophytic conditions. *Asplenium cheilosorum* with  $n='2n'=108=3x$  (cf. Mehra & Bir 1960, 1964) from the Himalayas and central-south Indian mountains is one such example.

### 3. *Adiantum capillus-veneris* L.

This is very rare fern of the Nilgiris growing on shaded dripping rocks. It is diploid sexual ( $n=30$ ) exhibiting extremely uniform cytological status throughout the Indian region i.e. Himalayas, north Indian Plains, central India (Pachmarhi), Parasnath Hills, south India (Bir & Verma 1989).

### 4. *Adiantum raddianum* Presl

This common fern of the Nilgiris is octaploid sexual showing  $n=114$  (Figure 2B) as revealed by analysis of Coonoor material. Taking the well established  $x=29$  and  $x=30$  as basic numbers for *Adiantum* L. (cf. Bir & Verma 1989) this turns out to be aneuploid number. The other reports for the species from south India are highly variable i.e.  $n=114$ , 8x aneuploid (Manickam 1984, Irudayaraj & Manickam 1987, Manickam & Irudayaraj 1988: from western Ghats, south of Palghat gap),  $n=58$ , 4x and  $n='2n'=87$ , 3x apogamous (Ghatak 1977 from the Shevaroy Hills),  $n=60$ , 4x (Irudayaraj & Manickam 1986) and  $n=57$ ,  $2n=114$  (Abraham, Ninan & Mathew 1962). The Nilgiris specimen exactly matches the western Ghats material of Irudayaraj & Manickam (1987), Manickam & Irudayaraj (1988) and Irudayaraj (1990). It also resembles Shevroy Hills material (RHT 33267), which is also  $n=114$  indicating complete uniformity of octaploid sexual plants. The vouchers of tetraploid plants with  $n=57$ , 58 or 60 and  $2n=114$  were not available for comparison, nevertheless *A. raddianum* is now known to be 'species complex' in south India with 3x apogamous and 4x, 8x sexual forms and it requires intensive studies on a population basis to resolve the origin of the various cytotypes.

### 5. *Pteridium aquilinum* (L.) Kuhn ex Decken

The bracken fern, which is reported either as *P. aquilinum* (Abraham, Ninan & Mathew 1962, Roy & Sakaya 1963, Khullar, Sharma & Verma 1988) or as *P. aquilinum* var. *wightianium* (Wall.) Löve & Löve (Kuriachan 1968, Mehra & Verma 1960, Ghatak 1977, Bir & Vasudeva 1979) is very common throughout the Himalayas and mountains of central (Pachmarhi) south India (Palnis, Nilgiris, Anamalais, etc.). It is cytologically very uniform showing  $n=52$ , 2x (Figure 2c). Vouchers indicate that the materials reported as var. *wightianium* from the western Himalayas and south India are all identical to those of the Nilgiris.

### 6. *Trichomanes schmidianum* Zenker ex Taschn.

Material of this rare species from Ithalaru at 1,900m showed 72 IIs in spore mother cells (Figure 2D) and 144 chromosomes in the archesporial cells of the sporangia. This taxon is known under a variety of names such as *Trichomanes*, *Vandenboschia*, *Crepidomanes*, and *Lacosteopsis* (for synonymy see Manickam & Irudayaraj 1992). Accepting the synonyms for this taxon, the only report from India is by Mehra & Singh (1957) who reported  $n=36$  in a material from Darjeeling, eastern Himalayas under the name *Vandenboschia pyxidifera* (non L.) Copel.[=*Trichomanes pyxidiferum* (non L.) Ogata] and scored it as octoploid in taking  $x=9$  as basic number for *Vandenboschia* Copel. Following this, the Nilgiris material with  $n=72$ ,  $2n=144$  is scored as 16-ploid. The Japanese material of this fern studied by Mitui (1968) under the synonymous name *Vandenboschia titibuensis* H. Ito with  $2n=108$  is scored as 12-ploid. Otherwise in treating



these two taxa under *Trichomanes* Linn., with  $x=18$ , the ploidy levels turn out to be octoploid and hexaploid respectively.

The type materials of *T. schmidianum* came from the Nilgiris and the *T. latifrons* Bosch was collected from Khasia Hills, eastern India (Iwatsuki 1985). Thus with the present study, *T. schmidianum* from the type locality in the Nilgiris, a new cytotype i.e. 16-ploid is added to the two cytotypes already known: 8x from Darjeeling and 12x from Japan. Material from the Palni Hills also shows  $n=72$ , 16x (Irudayaraj & Manickam unpublished). Based on the size of the frond (Figure 1, inset) our material is included in var. *schmidianum* (cf. Iwatsuki 1985) and characteristically lacks false veins but possesses extruded receptacles. No specific characters can be given for separating the Darjeeling 8-ploid and Nilgiris 16-ploid specimens.

#### 7. *Pseudocyclosorus ochthodes* (Kunze) Holttum

The present record of  $n=35$ , 2x (Figures 2E, F) agrees with the findings of Irudayaraj & Manickam (1986, 1987) and Manickam & Irudayaraj (1988) from Palni Hills, south India. Depending upon habitat conditions this species is endemic to south India with type material coming from the Nilgiris (Kunze 1851 as *Aspidium ochthodes*). Although it is highly variable in phenotypic characters it is cytologically extremely uniform.

The closely related species *Pseudocyclosorus tylodes* (Kunze) Ching is also diploid in the Nilgiris (Irudayaraj, Bir & Manickam 1993) and elsewhere in India (eastern Himalayas: Loyal 1961, Singh & Roy 1988; western Himalayas: Khullar, Sharma & Singh 1983) but with  $n=36$  being probably an aneuploid number with  $x=35$  for genus. The type specimen of *P. tylodes* is also from the Nilgiris.

#### 8. *Tectaria coadunata* (J. Smith) C.Chr.

The finding of  $n=41$  in Nilgiris material (Naduvattam: Gudalur road) for this species does not agree with the earlier recordings of  $n=40$  from the eastern and western Himalayas and central and south India (Bir & Verma 1989). However, it agrees with the  $n=41$  scored by Irudayaraj & Manickam (1987) from south India. The genus *Tectaria* Cav. is considered on world-wide data to be based on  $x=40$  and the number recorded by us (as well as by Irudayaraj and Manickam) is an aneuploid number probably originating from 10. The lower surface of the lamina is densely hirsute because the surfaces of costae have numerous long hairs (c. 0.5mm) which are also present in-between the veins. The Nilgiris material is, therefore, separated as var. *hirsuta* (Manickam & Irudayaraj 1992). There are no marked phenotypic differences between the Himalayan and the central and the south Indian cytologically investigated material.

#### 9. *Dryopsis scabrosa* (Kunze) Holttum & Edwards

Our finding of  $n=41$ , 2x from the type locality in Nilgiris is in agreement with the earlier records of both Ghatak (1977) and Manickam and Irudayaraj (1988) from peninsular India. This species was wrongly assigned to *Ctenitis* (C.Chr.) C.Chr which according to Holttum (1985) and Holttum & Edwards (1986) is totally absent from India.

#### 10. *Dryopteris cochleata* (Buch. Ham. ex D.Don) C.Chr.

This fern is very stable cytologically throughout India and Nepal. The only record is of  $n=41$ ,  $2n=82=2x$  from western Himalayas, central Himalayas (Nepal), Indo-Nepal Border, Parasnath Hills, central India and south India (Bir & Verma 1989). The Nilgiris material is also diploid sexual.

In analysing the cytological results obtained from the Nilgiris ferns (Irudayaraj, Bir & Manickam 1993, Irudayaraj & Bir 1994 and the present investigations) it can be seen that out of the 32 species studied there are 12 diploid sexual, 4 triploid apogamous, 13 tetraploid sexual, 2 octoploid sexual and one 16-ploid sexual species. Thus, there is an overall incidence of 62.5% polyploidy (diploids 37.5%) and 12.5% hybridity at triploid level with all of these hybrids being

apomicts. All the investigated species grow at or above 1,500m altitude i.e. under the moderately warm and moist conditions of the *shola* forests, so there is no altitudinal difference in distribution between the diploid and the polyploid species.

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**BOOK REVIEW****COMPARATIVE ETHNOBOTANICAL STUDIES OF THE AMERINDIAN GROUPS IN COASTAL ECUADOR**

By Anders S. Barfod and Lars Peter Kvist, 1996. The Royal Danish Academy of Sciences and Letters, Copenhagen. (=Biologiske Skrifter 46) 166pp. 14 b&w, 1 colour plates (=52 photos).

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Slowly, but nonetheless surely, a reasonable picture of the ethnobotany of the peoples of South America is beginning to emerge. As, piece by piece, the jigsaw is filled in, the remarkable depth and diversity of ethnobotanical knowledge which these peoples possess, and the complexity and profundity of their relationships with their environments, are becoming clear. With their substantial new work on the native peoples of coastal Ecuador - the Cayapas, Coaiqueres and Colorados - Barfod and Kvist have made a valuable contribution to the overall picture.

The publication is presented in the typical form of a scientific paper, with an introduction to the region, peoples and methods, and an overall presentation and discussion of the results. The comparative nature of this study is interesting, as we still know very little about exchange or parallel evolution of ethnobotanical knowledge among tribal groups. It would be interesting to see the data discussed in the wider context.

There are a number of interesting plates and drawings. By far the greater part of the book, however, is taken up by tables presenting the results of the surveys as lists of species by usage categories, and comparing and analysing the overall results from the three tribes. The data are easily accessible and will be useful for ethnobotanists attempting other comparative analyses, but does make light reading.

For the South American ethnobotanist this book is of very considerable interest. For the general pteridologist, perhaps less so. However, we are still appallingly ignorant of the ways in which ferns are put to use by man, and the ethnopteridological data presented here constitute a valuable and substantial contribution. Their most common uses were as medicines, mostly applied topically, and as vegetables or sources of fibres. It was interesting to see that they were, in terms of numbers of uses registered, the most important plant group (compared with angiosperm families) for both the Cayapa and the Colorado, and the second most important group for the Coiaquer. The importance of ferns to these tribes appears to be unusually high. Or is it? The picture needs more filling.

William Milliken



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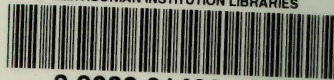
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